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JUL 12 1968

Scientific and Technical Aerospace Reports

EMIMONTHLY ABSTRACT JOURNAL WITH INDEXES

JUNE 23, 1968

VOLUME 6 ● NUMBER 12

N68-21845—N68-23044

PUBLIC DOCUMENTS DEPT.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Scientific and Technical Aerospace Reports, Volume 6, is prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Documentation Incorporated.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget June 7, 1966.

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02 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. 1815

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Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. 1817

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Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics. 1844

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Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. 1847

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. 1851

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. 1854

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Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. 1858

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Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. 1864

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Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. 1870

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Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; reliability; drafting; and materials fabrication, handling, and inspection. 1881

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Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers. 1896

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Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. **1900**

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Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. **1901**

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Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems. **1902**

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Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics. **1952**

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Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems. **1958**

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants. **1960**

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Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear. **1962**

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Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbits and trajectories. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. **1964**

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

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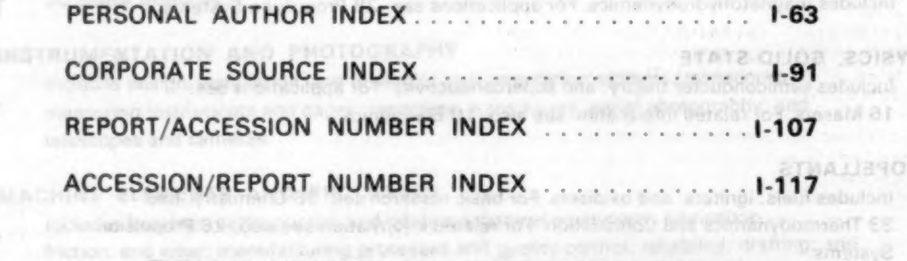

N68-15250*# Solar, San Diego, Calif.
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs
(Contract NAS7-469)
(NASA-CR-81140; RDR-1534-2) CFSTI: HC $3.00/MF $0.65
CSCL 11F

The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43. Author

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N68-21903# National Physical Lab., Teddington (England). Aerodynamics Div.

AN EXPERIMENTAL INVESTIGATION OF WALL INTERFERENCE EFFECTS ON DYNAMIC MEASUREMENTS ON HALF-MODELS IN VENTILATED TUNNELS THROUGH THE TRANSONIC SPEED RANGE

A. W. Moore and K. C. Wight 3 Aug. 1967 77 p refs

(NPL-AERO-1243; ARC-29331) CFSTI: HC$3.00/MF$0.65

An experimental investigation using four ventilated tunnels shows that wall interference on dynamic measurements grows with subsonic Mach number and usually persists to low supersonic speeds. The supersonic interference is associated with an upstream propagation of disturbances in the plenum chamber. Tests in a perforated tunnel show interference effects in subsonic flow comparable with those for a slotted tunnel and equally serious effects at least up to M=1.35. Variation of diffuser suction to the plenum chambers behind the perforated walls was found to change the damping derivatives significantly. Author

N68-21908# Aeronautical Research Council (Gt. Brit.).

DYNAMIC TESTS ON FREE-FLYING MODELS OF SLENDER WINGS SUBJECTED TO SIDEGUSTS

W. E. Gray London HMSO 1968 17 p refs

(ARC-R&M-3460) CFSTI: HC$3.00/MF$0.65

Experiments with small dynamic models have confirmed that the motion of slender wings with fixed controls initiated by a sidegust is dominated by a dutch-roll oscillation during which large bank angles may be acquired. The tests revealed the importance of the changing forces and moments during penetration into a gust; these effects aggravate the severity of the rolling oscillation in cases where a long fuselage protrudes ahead of a thin wing and can lead to bank angles which are about twice those observed on a corresponding slender wing without fuselage. The presence of free forebody vortices may complicate the response on entering a gust. Author

N68-21938# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).

EXPERIMENTAL DATA FOR TANDEM CASCADE IN THE HIGH SUBSONIC REGION

C. Sieverding Sep. 1966 53 p refs

(VKI-IN-15; AD-666394)

The work is the first part of studies on the use of the tandem cascade concept for application in the field of high turning angles. Two 1.64:1 scale models of a tandem cascade stator - the second model was a slightly changed version of the original design - were tested in a cascade wind tunnel for free stream Mach numbers of M = .5 to .9 and incidence angles of I = -4 deg. to +8 deg. Pressure measurements upstream; downstream and on the blade surfaces as well as schlieren pictures were taken. Application of back pressure was found to be necessary in order to get highest efficiencies and static pressure ratio. Side wall flaring or suction of the boundary layer at the side walls seem to be advisable for further testing. Author (TAB)

N68-21940*# National Aeronautics and Space Administration. Langley Research Center, Cleveland, Ohio.

AERODYNAMIC CHARACTERISTICS IN PITCH OF A MODIFIED-HALF-RING-WING-BODY COMBINATION AT MACH 2.16 TO 3.70

Odell A. Morris and Milton Lamb Washington Apr. 1968 40 p refs

(NASA-TM-X-1551) CFSTI: HC$3.00/MF$0.65 CSCL 01A

An investigation has been conducted at Mach numbers from 2.16 to 3.70 to determine the aerodynamic characteristics in pitch of a modified-half-ring-wing model. The investigation also included tests of a swept-wing model. Both models had a wide flat body and could be fitted with various forebody and afterbody sections. Results of the investigation indicated that favorable interference-lift effects were obtained for both wing-body models at zero angle of attack, the largest effects occurring for the modified-half-ring-wing model. The maximum lift-drag ratios, however, were obtained with the swept-wing model since it produced greater lift-curve slopes than the modified-half-ring-wing model. The changes in forebody and afterbody shapes investigated for both models produced no significant changes in maximum lift-drag ratios, as compared with the ratios for the basic symmetrical body shape. Author

N68-21941*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A METHOD FOR PREDICTING SHOCK SHAPES AND PRESSURE DISTRIBUTIONS FOR A WIDE VARIETY OF BLUNT BODIES AT ZERO ANGLE OF ATTACK

George E. Kaattari Washington Apr. 1968 41 p refs
(NASA-TN-D-4539) CFSTI: HC$3.00/MF$0.65 CSCL 01A

A method is presented for determining shock envelopes and pressure distributions for a variety of blunt bodies at zero angle of attack. Correlation functions obtained from exact solutions are used to relate the shock standoff distance, at the stagnation and sonic points, to the body geometry. These functions were obtained for a perfect gas but may be applied for real gases in equilibrium flows. The method is restricted to cases where the bow shock is detached from the body and the flow over the forward face is subsonic. Results given by the method are shown to be in good agreement with experimental values. Author

N68-21950*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ANALYTICAL AND EXPERIMENTAL STUDY OF DYNAMIC CHARACTERISTICS OF TURBOPUMPS
H. Ohashi Washington Apr. 1968 115 p refs
(NASA-TN-D-4298) CFSTI: HC$3.00/MF$0.65 CSCL 13K

The response of pressure rise of turbopumps to fluctuating flow rate was studied analytically and experimentally. Unsteady flow around a two-dimensional, linear cascade of airfoils was solved and the frequency response of the deflection angle of the cascade was calculated for the periodically oscillating inlet condition. Based on the unsteady cascade theory, the dynamic characteristics of turbopumps were analyzed. For the evaluation of an approximate response, a simplified model theory was also developed, which enables the calculation to be made without entering into the details of the pump design. An experimental investigation was made to determine the dynamic characteristics of a centrifugal pump. The test showed that the analytical calculation was close to the experimental result. The limiting fluctuating frequency under which the dynamic characteristics agree with the quasi-static ones, was determined from the test result. The time constant of the response of pressure rise to a step-like change of flow rate was also derived. Author

N68-22002*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF SIMULATED WING DAMAGE ON THE AERODYNAMIC CHARACTERISTICS OF A SWEPT-WING AIRPLANE MODEL
Clyde Hayes Washington Apr. 1968 70 p
(NASA-TM-X-1550) CFSTI: HC$3.00/MF$0.65 CSCL 01A

An investigation was conducted to determine the effects of simulated wing damage on the aerodynamic characteristics of a swept-wing airplane model. Wing damage was simulated by removal of either a leading-edge portion or a trailing-edge portion of one wing panel or by removal of an entire wing panel. The investigation was conducted at Mach numbers from 1.70 to 2.86 at a constant Reynolds number of 2.25×10^6 per foot (7.38×10^6 per meter). The results of the investigation indicated that removing the leading- or trailing-edge portion of the wing or removing the entire wing panel led to a decrease in both lift-curve slope and maximum lift-drag ratio. At the lower Mach numbers, removal of the trailing edge caused a rolling moment slightly larger than that caused by removal of the leading edge. At the higher Mach numbers, however, the effect on rolling moment due to removal of the trailing edge was less than that caused by removal of the leading edge even though a larger area of the wing was removed. Except when the entire wing panel was removed, the roll induced by wing asymmetry could be offset by sideslip within reasonable limits of angle of attack and sideslip. Author

N68-22012# Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique.
INCIDENCE AND LEADING EDGE EFFECTS ON FLOW AROUND A FLAT PLATE AT MACH NUMBER 18 [EFFETS D'INCIDENCE ET DE BORD D'ATTAQUE SUR L'ECOULEMENT AUTOUR D'UNE PLAQUE PLANE A UN NOMBRE DE MACH DE 18]
Jean Allegre and Christian Bisch Dec. 1967 32 p refs In FRENCH
(Rept.-67-10) CFSTI: $3.00

Hypersonic wind tunnel tests were conducted to measure the partial pressures on a flat plate with positive and negative angles of incidence at Mach 18. The shock wave coordinates are obtained from pitot tube experiments and are verified by flow visualization using an electric emanation method. These data are compared with theoretical data, and a good accord is found for the measurement series on a tapered leading edge for which the blunt effect is assumed negligible. However, a poor correlation is found for the case where the effects of blunting are appreciable. Transl. by M.G.J.

N68-22082 California Univ., Los Angeles.
SECOND ORDER THEORY FOR UNSTEADY, SUBSONIC FLOW PAST SLENDER BODIES
James Dewey Revell (Ph.D. Thesis) 1966 292 p
Available from Univ. Microfilms: HC $13.30/MF $3.75 Order No. 67-4499

An analytical theory is developed to calculate second order corrections to the lift distribution at subsonic flight speeds on slender, pointed bodies of revolution which are executing small oscillatory, transverse vibratory deformations from a "wind axis" coordinate system (e.g., one translating with uniform velocity in the negative direction parallel to the body axis of symmetry in the absence of lateral motion). The analysis is one of successive approximation, employing the classical Munk–Jones slender body theory as the first approximation to the velocity perturbation potential. A consistent second approximation is carried throughout the analysis for the velocity potential equation, the pressure equation, and the boundary conditions to be satisfied on the body surface. Numerical results are presented for two closed parabolic arc bodies of revolutions to illustrate the theory. Applications of the results to flight dynamics, aeroelasticity and structural dynamics are discussed. Dissert. Abstr.

N68-22251*# Scripta Technica, Inc., Washington, D. C.
ON THE CAUSES OF DISCONTINUITY IN STAGE CHARACTERISTICS OF AN AXIAL COMPRESSOR WITH A RELATIVELY LARGE HUB DIAMETER [O PRICHINAKH RAZRYVA KHARAKTERISTIK STUPENI OSEVOGO KOMPRESSORA S BOL'SHIM OTNOSITEL'NYM DIAMETROM VTULKI]
G. A. Borisov, E. A. Lokshtanov, and L. E. Ol'shteyn Washington NASA Apr. 1968 14 p refs Transl. into ENGLISH from the Publ. "Lopatochnyye Mashiny i Struynyye Apparaty" Moscow, Mashinostr. Press, 1967 p 134–146
(Contract NASw-1694)
(NASA-TT-F-11583) CFSTI: HC$3.00/MF$0.65 CSCL 01A

When the hub diameter of an axial compressor is relatively large, the characteristics of axial stages undergo a break in the usual tests (stage–capacity–throttle, intake and ejection of air in the atmosphere). Missing in such cases are the transitional segments of characteristics between the right branch, which corresponds to the continuous flow-around, and the left branch, which reflects pressure characteristics. The present article shows that this phenomenon is related to the particulars of the formation of a breakaway flow in stages with a relatively large hub diameter. This, however, occurs not directly but only as a result of the effect of flow separation upon the stability of the entire stage–grid system. Author

N68-22349*# Techtran Corp., Glen Burnie, Md.

PRIMING AN AIR INLET IN UNSTEADY FLOW AT MACH 7 [AMORCAGE DE PRISE D'AIR EN ECOULEMENT INSTATIONNAIRE A MACH 7]

Jean Pierre Bourgeois and Otto Leuchter Washington NASA Apr. 1968 4 p refs Transl. into ENGLISH from Rech. Aerospatiale (Paris), No. 121, 1967 p 13–15
(Contract NASw-1695)
(NASA-TT-F-11665) CFSTI: $3.00 CSCL 01A

A wind tunnel study is presented of plane air-inlet models at Mach 7. It is found by experiment that priming air inlets with large contraction ratios can be achieved without any variation in the geometry of hypersonic wind tunnels. The essential condition is to arrange for a means permitting the rapid opening of the neck (diaphragm, fast-acting gate valve). Large pressure ratios between the upstream chamber and the measuring chamber are required. Author

N68-22428 Lockheed Missiles and Space Co., Palo Alto, Calif.

MODELING THE FLEXURAL-TORSIONAL WING OSCILLATIONS IN AN AIR FLOW (DETERMINATION OF THE CRITICAL FLUTTER VELOCITY)

P. S. Landa, Iu. V. Ponomarev, and S. P. Strelkov [1967] 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Tverd. Tela (Moscow), no. 3, 1967 p 186–191

An electronic analog computer method for determining the eignefunctions and eigenvalues of systems described by one-dimensional partial differential equations is applied to the problem of wing oscillations in an air flow to determine the critical flutter velocity and frequency. The method assures comparatively high accuracy and is also applicable for solving problems of nonuniform wing flutter. K.W.

N68-22429 Lockheed Missiles and Space Co., Palo Alto, Calif.

ASYMPTOTIC INVESTIGATION OF VISCOUS COMPRESSIBLE GAS FLOW AROUND A BLUNT BODY

A. A. Markov and L. A. Chudov [1968] 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk, Mekhn. Zhidk. i Gaza (Moscow), no. 4, 1967 p 29–39

Flow of a supersonic viscous gas around a blunt body is considered. A method is proposed which permits construction of an asymptotic expansion of any order in the small parameter ϵ, characterizing the coefficients of viscosity and heat conduction. An asymptotic is constructed which contains zero, first, and second order terms in ϵ. The results are compared with those of authors who used the method of external and internal expansion. Author

N68-22475*# Therm Advanced Research, Inc., Ithaca, N. Y.

INVISCID FLOW FIELD INDUCED BY A ROTOR IN GROUND EFFECT

Michael D. Greenberg and Alvin L. Kaskel Washington NASA May 1968 54 p refs
(Contract NAS1-6349)
(NASA-CR-1027) CFSTI: $3.00 CSCL 01A

The inviscid flow field induced by a rotor in ground effect is calculated based upon an actuator disk model of the rotor, for the case of a constant circulation distribution over the blade radius. The governing nonlinear integral equations are solved by a systematic iterative scheme which is similar to the Newton–Raphson method for the solution of nonlinear algebraic equations. Numerical results are presented for both the ground-effect case and the out-of-ground-effect limit. Author

N68-22486# Advisory Group for Aerospace Research and Development, Paris (France).

FLUID DYNAMICS OF ROTOR AND FAN SUPPORTED AIRCRAFT AT SUBSONIC SPEEDS

Sep. 1967 486 p refs Presented at the Specialists Meeting of the Fluid Dyn. Panel of AGARD, Goettingen, W. Germany, 11–13 Sep. 1967
(AGARD-CP-22) CFSTI: HC $3.00/MF $0.65

Papers on propulsion, structure and weight control, low-speed and high-speed aerodynamics, separated flow, transition from separated flow to attached flow, efficient acceleration of large masses of air, stability and control, and noise reduction are presented. For individual titles see N68-22487–N68-22509.

N68-22487# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

AERODYNAMIC STUDY OF ONE ELEMENT OF A HELICOPTER BLADE [ETUDE AERODYNAMIQUE D'UN ELEMENT DE PALE D'HELICOPTERE]

Philippe Poisson-Quinton and Alexandre de Sievers *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 32 p refs In FRENCH; ENGLISH summary
(See N68-22486 12-01)

For the aerodynamic calculation of a helicopter rotor, it is necessary to know the two-dimensional aerodynamic characteristics of blade airfoil sections; here, the main goal is to increase the maximum lift and to reduce the drag, being subjected to compressibility effects at high forward speed. A special mounting for two-dimensional transonic investigations is being built to simulate correctly the local Mach and Reynolds numbers of a modern rotor in flight. Preliminary research in incompressible flow has dealt with the effect of manufacturing inperfections of a real helicopter blade and with the maximum lift and lift/drag improvements by means of a cambered nose section covering the actual symmetrical airfoil; the theoretical calculation of the symmetrical and cambered profiles was carried out by rheoelectric methods in incompressible perfect flow. Good agreement between the electrical analogy computations and the experimental results shows that this method is very useful for a fast optimization of a family of profiles corresponding to given criteria. Author

N68-22489# National Gas Turbine Establishment, Pyestock (England).

ROTOR INDUCED FLOW

A. R. Seed *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 27 p refs (See N68-22486 12-01)

Circulation control by blowing enables very high lift coefficients to be generated on a circular section aerofoil, so that a lifting rotor equipped with such a section can generate high thrust coefficients with comparatively few blades. An experimental investigation by hot wire anemometers on a two-bladed rotor shows that the induced velocity at the rotor disc has a periodic component which increases with rotor thrust coefficient. This periodicity is only adequately predicted theoretically by considering the actual trailing vortex system of the rotor. Vortex theory is also used to give an indication of the induced flow field in forward flight. The conclusions from these analyses of the circulation controlled rotor are shown to apply to conventional rotors operating at comparable loadings. The use of an electromagnetic analog for induced flow measurements is briefly discussed. Author

N68-22490# Vereinigte Flugtechnische Werke G.m.b.H., Munich (West Germany).

A CONTRIBUTION ON THE DETERMINATION OF OVERALL FORCES OF INCLINED PROPELLERS

B. Laschka, A. Mueller, and P. Ebeling *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 21 p refs (See N68-22486 12-01)

It is well-known that propellers operating at an angle of attack with respect to free stream velocity experience appreciable airloads acting in all directions. The knowledge of the magnitude of these effects is of great importance for the design of tilt propeller aircraft. For design aspects the local force distribution over the blade is of minor importance whereas primarily the overall forces of the whole propeller are of interest. This is especially true if a great number of parametric studies is to be performed. Therefore an approach to determine these forces and moments in a quick and sufficiently accurate way will be outlined. Besides the geometry of the blades only the (theoretical or experimental) performance charts of the propeller with zero incidence have to be available as basis for the calculations in terms of power and thrust coefficients versus advance ratio for different blade settings. A rough analysis of harmonics of higher order is possible. Comparison with experimental results of a NASA tested propeller reveals good agreement even at high incidence and advance ratio. Author

N68-22491# Carleton Univ., Ottawa (Ontario).

ANALYTIC DETERMINATION OF THE AXIAL VELOCITY THROUGH A PROPELLER MOVING PERPENDICULAR TO ITS AXIS

P. Mandl *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 30 p refs (See N68-22486 12-01)

A theory is developed for predicting the inflow through a propeller with finite blade number, moving at right angles to its axis. The mathematical model employed for the wake is that of a system of spiral surfaces, generated by skewed helices descending below the propeller disk at a prescribed rate. The strength of these helical vortices varies both with radius and blade azimuth. Based upon a combination of lifting-line, lifting-surface concepts and the use of oblique curvilinear coordinates to describe the instantaneous shape of the spiral wake, a fundamental integral equation is derived relating the radially and time-varying downwash field to the radially and time-varying circulation distribution along the blades. By postulating harmonic blade loading explicit expressions are obtained for the variation of the inflow with both blade azimuth and blade span for any value of the advance ratio. By restricting the scope of the theory to the case of small advance ratios, the time-dependent, three-dimensional flow can be calculated as a small perturbation of the steady, axially symmetrical flow. The perturbation method also reveals that there exists a direct relationship between the harmonic of the downwash and corresponding harmonic of the loading. Author

N68-22492# Bell Helicopter Co., Fort Worth, Tex.

ROTARY WING BOUNDARY LAYER AND RELATED RESEARCHES

W. H. Tanner *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 14 p refs (See N68-22486 12-01)

Experimental studies have been carried out with respect to the boundary layer of a hovering rotor and related effects such as the forming tip vortex and stall. In forward flight, initial investigation of radial flow effects have been made. The techniques employed include flow visualization by means of an evaporative chemical, hot wire anemometer and special pressure instrumentation. Information is presented for hovering on the transition from laminar to turbulent flow, surface conditions, boundary layer flow direction, both unstalled and stalled, and other aerodynamic characteristics. Testing was conducted on model and full-scale helicopter rotors in the open atmosphere and in wind tunnels. Nonrotating simulation studies have also been carried out. Where applicable, theory-experiment comparisons are presented and discrepancies between present widely accepted theoretical techniques and the experimental results are noted. Author

N68-22493# Giravions Dorand Co., Paris (France).

CONTROL, BY BLOWING, OF THE LIMITED LAYER AND OF THE CIRCULATION, APPLIED TO SOME BLADE TIP FLAPS OF ROTARY WINGS TRAILING EDGE [CONTROLE, PAR SOUFFLAGE, DE LA COUCHE LIMITE ET DE LA CIRCULATION, APPLIQUE A DES VOLETS DE BORD DE FUITE D'EXTREMITE DE PALES ROTATIVES]

Rene Dorand *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 35 p refs In FRENCH; ENGLISH summary (See N68-22486 12-01)

This method is particularly intended for constant pitch rotary wings, controlled by trailing edge, blade tip flaps with a flowing slit. The aim is to determine the suitable relative depth of the flap as a function of the amount of power delivered to the rotor by the blowing slit, in order to be able to perform the following maneuvers correctly: vertical recovery by overall downward deflection of the flaps; transition to autorotation by overall upward deflection of the flaps; and lateral and longitudinal control during engine testing and in forward flight, by cyclic flap deflection. Three cases are considered: The overall power is converted into the jet and the flowing controls the circulation; A moderate part of the power is converted into the jet and the rotor is mechanically driven. The blowing improves the rotor performance. Autorotation without power and natural blowing with boundary layer control, with the hollow blades acting as a centrifugal compressor. Author

N68-22494# Societe Bertin et Cie, La Garenne-Columbes (France).

CONTROL OF DOWNSTREAM DIFFUSION ON DUCTED PROPELLER [CONTROLE DE DIFFUSION AVAL SUR HELICE CARENEE]

M. Lazareff *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 17 p In FRENCH; ENGLISH summary (See N68-22486 12-01)

The development of diffusion on the downstream jet of a ducted propeller operating at a speed close to hovering is summarized. Interesting experimental results are anticipated. Others are being gathered. The most outstanding overall results are given and discussed as to their practical significance. Furthermore, it is shown that an important diffusion of the jet facilitates the adaptation of the fairing inlet in transition flight. However, the adverse effect of diffusion in rapid translation is also brought out, as well as the advantage of achieving on the contrary, a certain amount of jet convergence for this flight regime. In conclusion, the ducted propeller can only be used to its full advantage if it is fitted with a downstream diffusion highly adjustable in flight. Technological solutions must be investigated to overcome the difficulties implied. Author

N68-22495*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THE CONVERSION OF THE ROTOR/WING AIRCRAFT

R. J. Huston and J. P. Shivers *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 30 p refs (See N68-22486 12-01) CSCL 01B

The principal problem associated with the conversion from wing-borne to rotor-borne flight is the possibility of a large attitude disturbance during the first revolution of the rotor. The aircraft disturbance is due to an oscillation of the lift center-of-pressure in a longitudinal and lateral direction at a frequency that is simply the number of blades multiplied by the rotor rotational speed. The results of a wind-tunnel study indicate that large-amplitude cyclic pitch is one means of eliminating the source of the aircraft disturbance for a three-bladed rotor/wing aircraft. In addition, the selection of four blades on a rotor/wing aircraft may so substantially reduce the disturbing moments that cyclic pitch is not required to eliminate the moments. The results of an analytical investigation indicate the disturbance may also be reduced in magnitude by a rapid initial rotor acceleration or by the use of an oscillation of the horizontal tail surfaces (elevons) at the frequency of the lift center-of-pressure oscillation. However, simultaneous use of the elevons for longitudinal and lateral control will increase the minimum conversion speeds. Author

N68-22496# Lockheed-California Co., Burbank.

ANALYSES OF STOWED ROTOR AERODYNAMIC/AEROELASTIC CHARACTERISTICS

Robert E. Dohham *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 33 p (See N68-22486 12-01)

The intrinsic characteristics of the aeroelastic phenomena which have traditionally limited the forward flight speed attainable by conventional helicopters have long been realized and understood. They derive principally from the compressibility effects encountered by an advancing rotor blade and the stall effects experienced by a retreating blade in very high speed flight. While both phenomena augment rotor power requirements, they exhibit their most profound effects in the form of unduly high rotor stress levels and aircraft vibration levels. Various means of extending the forward speed capability of the helicopter have been proposed and demonstrated. So far, the transformation of the pure helicopter into a compound helicopter has constituted the most successful and direct means of improving forward speed capability. The major factor responsible for the increased speed capability of the compound helicopter is the ability to operate the rotor in an unloaded condition at high forward speeds where the burden for providing lift and forward thrust may be left entirely to the fixed wing and auxiliary propulsion system, respectively. Author

N68-22497# Hawker Siddeley Aviation, Ltd., Hatfield (England).

INITIAL STUDIES OF JET LIFT SYSTEMS WITH FAN-LIKE EXHAUST CHARACTERISTICS FOR V/STOL TRANSPORT AIRCRAFT

T. K. Szlenkier, A. W. Bishop, and A. Hartmann *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 29 p refs Prepared jointly with Dornier-Werke G.m.b.H., Friedrichshafen, W. Germany (See N68-22486 12-01)

During 1964–65, joint studies were conducted of V/STOL military transports with jet lift engines. Although such engines have an excellent specific volume and weight, the exhaust velocity and temperature are higher than for lift fans, leading to inferior ground erosion, noise and infra-red radiation characteristics. High intensity mixing nozzles can be used to reduce the velocity and temperature of lift jets, but in a conventional installation an unacceptable thrust loss would occur due to jet interference with engine bay walls and exhaust doors. Therefore two systems are proposed, one permitting free mixing and another incorporating a simple ejector giving a small thrust augmentation. Analytical methods are used to select preferable nozzle arrangements and to predict ejector performance. Cold-air tests were conducted for nozzle assessment, to determine the best ejector setting, and to obtain the efflux dynamic pressure and thrust characteristics. The required pressure reduction was obtained and small thrust gains were demonstrated for the ejector systems. Interpretation of test results indicates that practically all undesirable effects of high velocity and temperature jets can be considerably reduced. Author

N68-22499# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).

AN ANALYTIC AND EXPERIMENTAL STUDY OF JET DEFLECTION IN A CROSS-FLOW

C. T. Crowe and H. Riesebieter *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 20 p refs (See N68-22486 12-01)

An equation based on a simple theoretical model was derived for jet trajectories as a function of the jet-cross-flow dynamic pressure ratio. A smoke tunnel study was also undertaken to determine the spread rate factor. Data on the smoke trajectories within a deflected jet and the dynamic pressure along the jet were reduced to provide the desired information. Author

N68-22501# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany).

INLET MEASUREMENTS ON A VTOL-AIRCRAFT MODEL

Rudolf Goethert *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 23 p refs (See N68-22486 12-01)

Wind tunnel stability tests were conducted to determine the aerodynamic characteristics of fuselage mounted air intakes on VTOL aircraft models during hovering and transition flight phases. The models used had three engines, two to produce pure lift, and a third for combined lift-cruise thrust by use of swivel cascades at the jet exit. Engine windmilling was also studied by means of scuttles arranged at the engine outlet in order to produce the pressure drop between the compressor's inlet plane and the jet outlet plane necessary for restarting. E.J.S.

N68-22507# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

TESTING SYSTEM FOR HELICOPTER ROTORS IN THE WIND TUNNEL AT MODANE-AVRIEUX [INSTALLATION D'ESSAIS DE ROTORS D'HELICOPTERES DANS LA GRANDE SOUFFLERIE DE MODANE-AVRIEUX]

Andre Schweisch *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Sep. 1967 10 p refs In FRENCH; ENGLISH summary (See N68-22486 12-01)

A testing system for helicopter rotors and S/VTOL propellers used in one of the 8m. removable test-sections of a sonic wind-tunnel is described. This system allows testing large diameter rotors whose axes can be rotated in the vertical plane. The test-section is 8 m in diameter and 14 m in length. The maximum useful power is 736 kW and the rotor rotation rate can be continuously varied from 800 r.p.m. to 2300 r.p.m. A braking device allows autorotation testing. A six-component balance supports the hub of the rotor and measures the resulting aerodynamic torque. A collector including 50 rings provides the electric outputs from the rotating parts of the rotor (loads on the pitch-control rods, local pressure on the blades, main stresses). The blade wake can be explored and a stroboscopic device allows detecting the deformation of the blades. The technological aspects of the system, the measuring equipment and the expected performance are described. Author

N68-22579*# General Motors Corp., Indianapolis, Ind. Allison Div.

SINGLE-STAGE EXPERIMENTAL EVALUATION OF BOUNDARY LAYER BLOWING TECHNIQUES FOR HIGH LIFT STATOR BLADES. 1: COMPRESSOR DESIGN

M. L. Miller and D. C. Chapman Feb. 1968 104 p
(Contract NAS3-7619)
(NASA-CR-54564; EDR-5636, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 21E

Three stator blade sets were designed for use in investigating the effectiveness of boundary layer control by blowing as a means of reducing losses and increasing stall-free range for highly loaded axial flow compressor blading. This study was limited to stators to minimize mechanical problems. The source of blowing air was chosen as the region of high pressure on the pressure surface of the blade near the leading edge. Boundary layer analyses were made to predict boundary layer growth and points of separation using pressure distributions that were obtained from extrapolation of cascade data. Slots were designed to reenergize the boundary layer air by blowing. Blowing air is inducted through a spanwise slot on the pressure surface of the blade near the leading edge into the vane core and is released through the slot or slots in the suction surface located appropriately upstream of the predicted separation point. The slots are formed by a simple planar cut of constant width with the minimum mechanically feasible inclination to the local surface tangent. Author

N68-22651# Aeronautical Research Council (Gt. Brit.).
THE DRAG OF SOME WEDGE CENTRE-BODY INTAKES AT MACH NUMBERS OF 1.56, 1.86 AND 2.14
R. A. Dutton and E. L. Goldsmith 1967 69 p refs Supersedes RAE-TR-66208; ARC-28449; see X67-13790
(ARC-CP-968; RAE-TR-66208; ARC-28449) CFSTI: HC $3.00/MF $0.65

Experimental measurements were made of the drag and pressure recovery of a wedge center-body intake of rectangular cross-section. Intakes with four different wedges (12°, 16°, 20° and 24° semi apex angle) were tested at Mach 1.56, 1.86, and 2.14. The measurements were obtained for the following three different flow states: with both the wedge and cowl lip shocks attached, with only the wedge shock attached, and finally with the wedge shock detached. The results are compared with those from an approximate method of calculation. With the wedge shock attached, the spillage drag can be estimated reasonably well but when the wedge shock is detached the agreement between experimental and calculated results is poor. Curves showing the variation of capture ratio and pre-entry drag at full mass flow with M for particular wedge angles, and curves giving the cowl drag at full mass flow for families of both straight line and elliptical cowl profiles are presented. Author

N68-22652# Aeronautical Research Council (Gt. Brit.).
MEASUREMENTS OF SKIN FRICTION ON A CAMBERED DELTA WING AT SUPERSONIC SPEEDS
K. G. Winter and K. G. Smith 1967 45 p refs Supersedes RAE-TR-65181; ARC-27559; see X66-13401
(ARC-R+M-3501; RAE-TR-65181; ARC-27559) CFSTI: HC $3.00/MF $0.65

The measurements, using razor blade surface pitot tubes, show that the relatively mild pressure gradients and streamline convergence on the wing have a large effect on local skin friction. Application of the boundary layer momentum equation suggests that the change in skin friction arises directly from changes in the boundary layer profile. Despite large variations the total skin friction drag of the wing is within 10 per cent of that of a flat plate. Author

N68-22653# Aeronautical Research Council (Gt. Brit.)
THE LAMINAR BOUNDARY LAYER ON AN INCLINED CONE
J. C. Cooke Aug. 1965 20 p refs Submitted for publication Supersedes RAE-TN-65178; ARC-27416; see X66-11914 and N66-28864
(ARC-T+M-3530; RAE-TN-65178; ARC-27416) CFSTI: HC $3.00/MF $0.65

A solution to the problem of incompressible conical flow past a cone is presented in which the boundary layer equations are solved by an implicit finite difference procedure. Comparisons are made with experiments by Rainbird, Crabbe, and Jurewicz, and with calculations made by Crabbe, who used an approximate method due to Cooke. The present calculations agree reasonably well with experiments and show that the approximate method gives a fair overall picture. Author

N68-22655# Aeronautical Research Council (Gt. Brit.)
MEASUREMENTS OF WING BUFFETING ON A SCIMITAR MODEL
D. G. Mabey 1967 25 p refs Supersedes RAE-TR-66160; ARC-28632; see X67-13797
(ARC-CP-954; RAE-TR-66160; ARC-28632) CFSTI: HC $3.00/MF $0.65

Measurements of unsteady wing-root strain were made on a small solid model of the Scimitar Mk.1 aircraft to investigate the buffeting scaling relationships. The wing-root strain measurements covered an incidence range from 0° to 13° at Mach 0.50 and a wide range of stream density. The derived buffeting scaling relationships show that the damping of the wing buffeting is predominantly structural (even though the structural damping coefficient on this model is low) because the aerodynamic damping coefficient is low owing to the high model density. Models with structural and aerodynamic damping coefficients more representative of full scale values should be used for measurements of the level of buffeting. Author

N68-22730*# National Aeronautics and Space Administration, Washington, D. C.
ON THE HISTORICAL DEVELOPMENT OF FLIGHT DYNAMICS [ZUR ENTWICKLUNGSGESCHICHTE DER FLUGMECHANIK]
H. Herb Apr. 1968 154 p refs Transl. into ENGLISH from the German Rept. DRL-67-44
(NASA-TT-F-498) CFSTI: $3.00 CSCL 01A

The development of aircraft construction advanced due to the progress made in the field of flight dynamics and aerodynamics inclusive. Starting from the subdivisions "weight and lift," "performance," and "stability and control" the progress of development is analyzed by means of old and modern aircraft data: the results are represented in diagrams. Prognostic estimations formerly made by experts for the future development are often cited. It has been evident that the actual development in all considered cases proceeded more favorably than predicted by prognostic estimations. Author

N68-22891# Oklahoma State Univ., Stillwater.
A TECHNIQUE FOR STUDYING INTERACTIONS BETWEEN A SUPERSONIC BODY AND BLAST WAVES APPROACHING OBLIQUELY
Rusi Jal Damkevala and Glen W. Zumwalt May 1967 122 p refs Prepared for Sandia Corp.
(SC-CR-67-2533) CFSTI: HC $3.00/MF $0.65

A technique was developed for studying the oblique shock-on-shock interactions between a rifle-launched model and a cylindrical shock wave from a shock tube. The interaction angle could vary from 0° and 90° (head-on), depending upon the distance from the end of the shock tube to the point at which the interaction was made to take place. In the present work, oblique interactions were studied and a sufficient number of photographs were obtained so that whole sequences of events at three selected shock strengths and model Mach numbers could be studied. Both air and Freon-114 were used as the medium in the interaction chamber. The model used for all the tests was a 19.5° cone-cylinder, the cylinder being 0.375" in diameter. Author (NSA)

N68-23038# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDYING FLOW AROUND ELLIPTICAL CONES [ISSLEDOVANIYE OBTEKANIYA ELLIPTICHESKIKH KONUSOV]
A. I. Shvets 8 Sep. 1967 15 p refs Transl. into ENGLISH from Izv. Mekhan. Zhidkosti i Gaza (Moscow), no. 1, 1966 p 130–137
(FTD-HT-67-70; AD-666740)

An experimental investigation of three-dimensional transonic and supersonic flows past elliptic cones in an aerodynamic wind tunnel is presented. Six models of elliptic cones with different eccentricities and half-cone angles were investigated. The results are presented in graphs and compared with available theoretical and experimental data obtained by many authors. The comparisons show that the nonlinear thinbody theory agrees satisfactorily with experimental data for slender elliptic cones in a limited range of M; however, the theoretical values lie substantially lower than the experimental values, in proportion to the increases in flow velocity and cone width. Various methods used for calculating supersonic and hypersonic flows around conic bodies are reviewed, analyzed, and at times compared. Comparisons of methods such as tangential and equivalent-cone with the improved equivalent-cone method of Willi F. Jacobs show that the results of the first two agree satisfactorily with experiment only for bodies which do not deviate substantially from circular cones, though those obtained by the third method agree much better with experimental data. Optical investigations of all models at low M numbers showed that the shock fronts retain the same form of nearly circular cones and the local angle of the compression shock depends more on surface distribution along the body axis than on the shape of the body cross section. As the flow velocity increases, the shape of the shock wave in the section normal to the direction of flow approaches the shape of the body and the compression shock takes a conic, nonaxisymmetric form. Author (TAB)

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N68-22033*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN INVESTIGATION OF THE HELICOPTER HEIGHT VELOCITY DIAGRAM SHOWING EFFECTS OF DENSITY ALTITUDE AND GROSS WEIGHT
Robert J. Pegg Washington May 1968 33 p refs
(NASA-TN-D-4536) CFSTI: HC$3.00/MF$0.65 CSCL 01C

Within the limitations of the available data, this report is intended to provide a method by which experimentally determined helicopter height-velocity diagrams may be modified to show the effects of density altitude and gross weight. Variations in the established height-velocity diagram can be predicted for changes in density altitude and gross weight by using a generalized nondimensional curve. This generalized curve is based on semiempirical functions derived from flight-test data. During the flight testing of new helicopter designs, this semiempirical method can be used advantageously to predict changes in autorotation characteristics. This method can also predict the approximate shape of the height-velocity diagram while preliminary designs of a helicopter are being made. To illustrate the use of the semiempirical procedure, a detailed numerical example is given. The step-by-step calculations show the use of the curves and equations. Author

N68-22034# Technisch Documentatie en Informatie Centrum vor die Krijgsmacht, The Hague (Netherlands).
BIRD HAZARDS TO AIRCRAFT: A LITERATURE SURVEY, JANUARY 1947–SEPTEMBER 1967
J. Wijnen Oct. 1967 55 p refs In FRENCH; ENGLISH, GERMAN, and DUTCH
(TDCK-49208) CFSTI: HC $3.00

An annotated bibliography on bird hazards to aircraft is presented. The literature covered includes reports on: bird strikes, accident reports, impact tests, engine ingestion, bird movements forecasting, and both passive and active methods of dispersing birds in the vicinity of airfields. E.J.S.

N68-22053 Toronto Univ. (Ontario).
THE LIGHT-LINE-TETHERING TECHNIQUE FOR DETERMINING THE AERODYNAMIC DERIVATIVES OF AN AIR CUSHION VEHICLE
George Kurylowich (Ph.D. Thesis) 1966 54 p
Available from Natl. Library of Can. at Ottawa: MF$1.50

A complete feasibility study was performed on a technique for determining aerodynamic derivatives of an Air Cushion Vehicle. A circular track simulated ground while the vehicle, tethered to a centerpost by means of a light cable, flew a circular flight path above the track surface. A step on the ground perturbed the vehicle from equilibrium and the resulting oscillations were recorded by a movie camera. These data were used in conjunction with the system equations of motion to derive the unknown aerodynamic coefficients of the latter by a least-squares procedure. The results obtained indicated that many derivatives were functions of height Dissert. Abstr.

N68-22115# Centre National d'Etudes Spatiales, Paris (France).
PRESSURIZED BALLOON [LES BALLONS PRESSURISES]
Jaques Vergu (Ecole Natl. Super. d'Arts et Metiers, Paris) Mar. 1968 40 p refs In FRENCH
(CNES-NT-8)

A theoretical study of pressurized balloons is presented. The criteria are delineated for the selection of structural materials, aerostatic gases, and procedures for balloon inflation and launching. Altitude variations as a function of temperature are considered, and equations of equilibrium are derived for maximum balloon height. The performance of pressurized balloons under optimal conditions is also evaluated. Transl. by B.S.D.

N68-22291*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUMMARY OF VGH DATA COLLECTED ON ONE TYPE OF TWIN-ENGINE JET AIRPLANE DURING AIRLINE OPERATIONS
Paul A. Hunter and Marian E. Brazziel Washington May 1968 32 p refs
(NASA-TN-D-4529) CFSTI: HC$3.00/MF$0.65 CSCL 01C

A VGH data sample collected on two identical twin-engine turbojet airplanes during routine airline operations has been analyzed to determine the operational experiences of the airplanes. The results indicate that the gust and maneuver accelerations are comparable to corresponding results for turboprop airplanes. Accelerations due to oscillatory motions were of low amplitude, were experienced infrequently, and are considered insignificant in regard to the total airplane acceleration experience. The results indicate that the gust velocity experience for the twin-engine jet airplane is significantly lower than the experience for two types of turboprop airplanes and is comparable to that for a four-engine turbojet transport. Placard-speed exceedances were relatively infrequent and were generally less than 6 knots beyond the overspeed warning bell. The results indicate that, in general, airspeed reduction was practiced during the more severe turbulence. The landing-impact accelerations, which were quite severe during the initial airplane operation, were reduced to a level comparable to that of several other two- and three-engine jet transports after a modification of the landing gear. Author

N68-22320# Advisory Group for Aerospace Research and Development, Paris (France).
MANEUVERABILITY AND GUST RESPONSE PROBLEMS ASSOCIATED WITH LOW-ALTITUDE, HIGH-SPEED FLIGHT
Ralph C. A'Harrah Oct. 1967 65 p refs
(AGARD-556) CFSTI: HC$3.00/MF$0.65

Review of the fundamental factors associated with the maneuverability (flying qualities) and gust response (riding qualities) problems in low altitude, high speed flight from rigid body considerations. The implications of various potential solutions from the viewpoint of improving the low altitude, high speed characteristics of both current and future aircraft are indicated. The results pertain primarily to relatively small, high-load-factor aircraft. For large aircraft, the results are also relevant but consideration must be given to the structural dynamic aspects. It is concluded that the considerable research and development efforts devoted to the LAHS gust and maneuvering response problems over the past decade have elevated the state of knowledge to a level compatible with that of the more commonly used flight regimes; also that the major impact of LAHS flight has been to focus attention on improved information display techniques, improved flying qualities criteria, improved control technology and a realistic appraisal of the external disturbance considerations. Author

N68-22488# Lockheed-California Co., Burbank.

LIFTING ROTORS OPERATING AT HIGH SPEEDS OR ADVANCE RATIOS

G. J. Sissingh and J. Sweers *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 25 p refs (See N68-22486 12-01)

Flight tests are conducted on a compound helicopter, in which the time histories of aerodynamic lift and moment distribution over the rotor blade are measured simultaneously with blade banding and torsion moments, at flight speeds ranging from hover to 232 knots (430 km/h). The flight test measurements are compared with theoretical airloads distributions and blade bending moments, using various degrees of refinement of the theory. These refinements include the treatment of the wake vorticity, the use of two dimensional profile data, the effect of local Mach number, the effects of blade flexibility and coupling between bending about two axes and torsion, and the interaction between blade response and airloads. The second part deals with the effect of the advance ratio on the response and stability characteristics of the flapping motion. A rotor blade operating at high advance ratios represents a dynamic system with periodically (but not harmonic) changing spring and damper coefficients, i.e., it is characterized by a Hill-type equation of motion. In order to determine the behavior of such a system, its stability boundaries and response to various types of excitations are investigated by electronic analog simulation. Author

N68-22498*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AERODYNAMICS OF V/STOL AIRCRAFT POWERED BY LIFT FANS

David H. Hickey and Woodrow L. Cook *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 18 p refs (See N68-22486 12-01) CSCL 01C

Described is a comprehensive experimental research program with large-scale V/STOL models powered with lift fans to define the aerodynamic characteristics of fan powered aircraft in transition. Aerodynamic interference between the fans and the airframe, transition performance, stability and control, and installation problems are being studied. Configurations examined thus far include single and multiple fan-in-wing arrangements, remote fuselage-mounted fans, and tandem fans. This paper will summarize these experimental results and discuss the calculation of some of the more important characteristics. Specifically, the topics to be covered are induced lift, drag, moment variation with airspeed, trailing-edge flap contributions, ground effect in hover, transition performance, and the application of boundary-layer control to lift-fan inlets. Author

N68-22500# Aerodynamische Versuchsanstalt, Gottingen (West Germany).

JET INTERFERENCE MEASUREMENTS ON A V/STOL-MODEL WITH JET SIMULATION BY FANS

H. Fuetterer and L. Harms *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 27 p refs (See N68-22486 12-01)

The performance of wind-tunnel tests on VTOL-models with lift-fan engines as well as the characteristics of these fan engines are described. The influence of the fan efflux flow on the lift and pitching moment of the fuselage, wing and tailplane is determined from three-component measurements in the low speed wind-tunnel of the AVA. The ratio of flight speed V_∞ to the jet velocity V_j of the fan units is changed in the range from $V_\infty/V_j=0.2$ to about 0.6 and the jet inclination of a combined thrust-lift engine is varied from $\theta=0°$ to 90°. The basic assumptions on which this particular technique is based, the calibration tests performed, and the data-reduction methods are described. The results obtained are compared with corresponding measurements on similar models. Author

N68-22502# McDonnell Aircraft Corp., St. Louis, Mo.

POWER EFFECTS ON TWO-FAN-IN-FUSELAGE FIGHTER CONFIGURATION

R. B. Jenny *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 20 p (See N68-22486 12-01)

During the past three years, two powered models of fan-in-fuselage VTOL airplanes have been tested. These models represent a supersonic VTOL fighter configuration with three fans in the fuselage, and a subsonic VTOL fighter configuration with two fans in the fuselage. The fan performance was determined to be quite sensitive to inlet geometry. The effects of ground proximity were found to be quite small. Exit louvers were found to be an effective device for controlling the thrust deflection angle, and the effects of louver area were measured. The interference effects on lift at forward speed were found to be sensitive to the position of the fan relative to the wing, and the interference drag was found to agree quite well with momentum theory. Author

N68-22503# London Univ. (England). Dept. of Aeronautics.

TRANSIENT AERODYNAMIC FORCES ON A TILT-PROPELLER VTOL AIRCRAFT IN HOVERING

A. R. S. Bramwell *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 14 p ref (See N68-22486 12-01)

Techniques are described for calculating the transient pressures and forces on surfaces near lifting rotor blades in VTOL configurations. The investigation shows that the interference forces can be very large when the rotor is close to the wing and the wing chord is large. For a rotor of given thrust, the transient loads are found to be inversely proportional to the number of blades. The mean value of these forces is small however, and not likely to seriously affect the aircraft performance, being generally smaller than the downwash drag effect. E.J.S.

N68-22504# National Gas Turbine Establishment, Pyestock (England).

VTOL AIRCRAFT NOISE

T. J. Hargest *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 18 p refs (See N68-22486 12-01)

Summary data are presented on noise reduction techniques and standards required for center city operation of VTOL aircraft. Various lifting systems are briefly discussed in terms of noise generated, and it is concluded that the application of circulation controlled rotors to the various lifting systems may reduce noise levels to the point that commercially viable VTOL aircraft could be built and operated from central city terminals. E.J.S.

N68-22506# Boeing Co., Morton, Pa. Vertol Div.

INFLUENCE OF THE TIP VORTEX ON HELICOPTER ROTOR NOISE

H. Sternfeld, Jr. *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 21 p refs (See N68-22486 12-01)

The acoustical signature of a helicopter lifting rotor is highly complex due to the number of various noise producing mechanisms which act simultaneously. One phenomenon, which it occurs, however, rises above all others and virtually sets the external noise level of the aircraft. This condition, known as blade bang or blade slap, arises from the intersection of a rotor blade with the tip vortex shed by a preceding blade in the rotor system. This paper discusses the differences between banging and non banging signatures and the conditions which result in blade vortex intersections. Correlation between acoustical signature and the analytical prediction of vortex interaction is shown. Experimental investigations utilizing smoke vizualization techniques are reported and illustrated with photographic sequences from motion pictures, showing the formation of the vortex core structure on a rotor test tower, and the intersection of rotor blades and tip vortices on a tandem rotor helicopter. Author

N68-22508# National Aeronautical Establishment, Ottawa (Ontario).

MEASUREMENTS OF THE INFLUENCE OF MIXED BOUNDARIES ON THE AERODYNAMIC CHARACTERISTICS OF A V/STOL WIND TUNNEL MODEL

P. South *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 16 p refs (See N68-22486 12-01)

Lift, drag, pitching moment, propeller thrust, and flow angle in the region of the tailplane were measured for a twin propeller tilt wing aircraft model in 15 foot diameter open, and closed working sections and in a number of 7 foot square sections. The wall effects were deduced by comparing the data from the 7 foot square sections with a set of reference data obtained by averaging the results of the tests in the 15 foot open, and closed working sections. For the completely open and completely closed working sections, the results are compared with the corrections predicted by Heyson's method. The tests in the mixed boundary working sections show that it is possible to greatly reduce the effect upon angle of attack by using suitable working sections and that it is also possible to modify the dynamic pressure effects but that mixed boundaries are not as effective in reducing the latter effects. Author

N68-22509# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).

V/STOL WIND TUNNEL TESTING—PAST DEVELOPMENT, EXPERIENCES AND FUTURE DEVELOPMENT

B. Ewald *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 23 p refs (See N68-22486 12-01)

A characteristic of all VSTOL aircraft is the presence of strongdownward jets, created by lifting rotors, fans or lift engines. At low flight speeds these jets induce forces on the aircraft of the same order of magnitude as the normal aerodynamic forces due to the forward flight. In addition the air intakes on the aircraft create aerodynamic forces of important magnitude. Therefore the simulation of air intakes and jets is requisite to meaningful wind tunnel testing of VSTOL aircraft. The testing techniques employed in this field and the experiences gained therewith are discussed. The similarity laws relating to simulation of air intakes and jets in wind tunnel and static tests are discussed. In the light of these laws a presentation is given of the different known techniques to simulate air intakes and jets. Several wind tunnel programs carried out are presented as examples to demonstrate different techniques. Future possibilities in the development of thrust simulation techniques are indicated. The correct simulation of intake flows and jets in wind tunnels not only dictates the testing technique but the capabilities of the associated equipment and the tunnel itself. In extreme circumstances this leads to the design and construction of special VSTOL wind tunnels. The properties required of such tunnels are discussed. Author

N68-22873# Aeronautical Research Council (Gt. Brit.).

FATIGUE TEST RESULTS AND ANALYSIS OF 42 PISTON PROVOST WINGS

H. E. Parish London HMSO 1968 Supersedes BAC-S&T-MEMO-1/65, ARC-27089; See X65-18691

(ARC-R&M-3474; BAC-S&T-MEMO-1/65; ARC-27083) HMSO: 6s 6d

Safe fatigue life of the Piston Provost was established by full-scale, programmed load fatigue tests, the load spectrum being collected from in-service records. Forty life-expired wings and an appropriate number of fuselages were used to continue the programmed load tests to failure with the object of determining the degree of scatter. The standard deviation of 0·087 and a coefficient of variation of 0·022 indicates less scatter than has been suggested in other literature. The estimated life obtained by using Miner's cumulative damage rule was compared with the mean of the experimental results. Author

N68-22886*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

METHOD OF CALCULATING THE NORMAL MODES AND FREQUENCIES OF A BRANCHED TIMOSHENKO BEAM

Francis J. Shaker Washington May 1968 41 p refs

(NASA-TN-D-4560) CFSTI: HC$3.00/MF$0.65 CSCL 20K

The method is essentially a modified Stodola method and requires an iteration procedure to determine the normal modes and frequencies of the system. In this method, an arbitrary deflection, consistent with the boundary condition, is assumed. Also, because of the presence of the spring-mass system, the frequency is not a constant factor in the governing equations and must also be assumed. Knowing the deflection and frequency, the corresponding shears, moments, slopes, and new deflection can be determined by integrating the governing differential equations of the system. The new deflection is then adjusted to satisfy the boundary conditions, and a new frequency is subsequently calculated. The process is then repeated, and the frequency is used as the criterion for convergence. Although the method can be applied for any type of boundary conditions, particular attention was given to those boundary conditions of interest in launch-vehicle dynamics, namely, the free-free beam and the cantilevered-free beam. Author

N68-23016# Royal Radar Establishment, Malvern (England).

PRELIMINARY RESULTS OF TRIALS TO DETERMINE THE MAXIMUM RANGE OF PERCEPTION OF FAST AIRCRAFT

H. E. Hoffman Apr. 1967 10 p Transl. into ENGLISH from German

(RRE-TRANS-171; TIL/OT/8641) CFSTI: HC$3.00/MF$0.65

Six diagrams are given showing maximum perception range of fast aircraft, as a function of horizontal standard visibility of unassisted obervers with and without binoculars. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N68-21879*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

FEASIBILITY STUDY OF A 30 WATTS PER POUND ROLL UP SOLAR ARRAY Quarterly Technical Report, 1 Jan.–31 Mar. 1968

N. F. Shepard, K. F. Merten, and F. A. Blake 15 Apr. 1968 138 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951970)
(NASA-CR-94243; Doc.-68SD4246; QTR-3) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Activities for establishing the feasibility of a 30 watts per pound roll-up solar array are reported. Included are the complete definition of a model to demonstrate the deployability of the selected flight array configuration, thermal cycling tests of a 5-cell by 5-cell module, and factors affecting the array blanket edge curling phenomenon. Author

N68-21943* Fairchild Hiller Corp., Germantown, Md. Space and Electronics Systems Div.

FABRICATION FEASIBILITY STUDY OF A 30 WATT/POUND ROLLUP SOLAR ARRAY Quarterly Report, Jan. 1–Mar. 31, 1968

15 Apr. 1968 74 p Prepared for JPL
(Contracts NAS7-100; JPL-951969)
(NASA-CR-94249; Rept.-652-00103-QR; QR-3) CFSTI: $3.00 CSCL 10A

During this period, efforts have concentrated on generation of the preliminary design for the flight hardware, modifications of such design for production of a full scale model which embodies the deployment/retraction techniques so selected, and the start of the fabrication of the full scale model. This report presents a description of the flight hardware design and includes detailed structural analysis of areas not previously covered. Author

N68-21998*# Ryan Aeronautical Co., San Diego, Calif.

FEASIBILITY STUDY 30 WATTS PER POUND ROLLUP SOLAR ARRAY Quarterly Report, 1 Jan.–31 Mar. 1968

15 Apr. 1968 60 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951971)
(NASA-CR-94245; Rept.-40067-3; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 10A

A quarter scale model of the solar array was fabricated during this reporting period. Demonstrations revealed two functional characteristics that could be improved. Preliminary design drawings are being revised and supporting analyses modified accordingly. A full scale demonstrations model is in process of construction, incorporating the design revisions being performed. A full scale wrap drum with representative wraps of the selected substrate materials and a simulated solar cell installation was subjected to vibration testing. Weight calculations have been revised to reflect the estimated effects of detail design changes. Performance of the solar array design is now projected as capable of producing 31.48 watts per pound of weight. Author

N68-22010# Bolkow Entwicklungen K. G., Munich (West Germany).

DEVELOPMENT OF ADVANCED SOLAR CELL MODULUS TECHNOLOGY FOR USE BY SOLAR PROBES AND LARGE AREA SOLAR CELL ARRAYS [ENTWICKLUNG VON FORTSCHRITTLICHEN SOLARZELLEN MODULTECHNOLOGIEN UNTER BERUECKSICHTIGUNG VON ANWENDUNGEN BEI SONNENSONDEN UND GROSSFLAECHIGEN SOLARZELLENANLAGEN]

Egon Mueller, Edgar Klippel, and Klaus Einfeld 1968 54 p refs In GERMAN Presented at the 2nd DGLR Symp. on Energy Supply in Interstellar Space, Munich, Mar. 1968 Supported in part by the Bundesmin. fuer Wiss. Forsch.
(RF-93-0; DGLR-68-003) CFSTI: HC $3.00/MF $0.65

A largely mechanized module technique for the fabrication of solar cells is described which specifically provides for resistance to thermal shock and thermal cycles. Mechanization of soldering and bonding makes this method especially suited for large-volume production. Silver lattice-foil structures joined by brazing are used for greater structural stability and to keep weight low. Air pockets and inclusions on bonded surfaces are avoided by bonding in vacuum. Transl. by K.W.

N68-22013# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Energiewandlung und Elektrische Antriebe.

ENERGY CONVERSION USING MAGNETOCALORIC AND ELECTROCALORIC EFFECTS [ENERGIEWANDLUNG MIT HILFE MAGNETOKALORISCHER UND ELEKTROKALORISCHER EFFEKTE]

Walter Peschka 1968 18 p refs In GERMAN Presented at the 2nd DGRR Symp. on Energy Supply in Interstellar Space, Munich, 14 Mar. 1968
(DGLR-68-005)

The principle of electrically conducting quasi-ferromagnetic liquids or suspensions is used to demonstrate that mechanical energy is also imparted to a non-ferromagnetic electrically conducting liquid when the working medium enters an alternating magnetic field in the vapor phase and then condenses. A portion of the heat required for vaporization occurs in the form of mechanical energy, i.e. increased pressure, and a magnetohydrodynamic (MHD) converter can be used to change the mechanical into electric energy. The process, in conjunction with regenerative heat exchangers and the MHD converter, can be adapted to the design of a thermodynamic loop which should be more efficient than condensing ejector systems without regenerative heat exchange. The application of electrocaloric effects in the conversion of heat into electric energy is briefly discussed. Transl. by K.W.

N68-22152 Indiana Univ., Bloomington.

ELECTRONIC COMMUTATOR EMF MEASUREMENTS OF CELLS CONTAINING MOLTEN SILVER AND LITHIUM HALIDES

Clyde Raymond Metz (Ph.D. Thesis) 1966 95 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-3695

The electronic commutator method for determining the reversible potential of formation for fused salts has been applied to AgCl, AgBr, and AgI from the melting points of 750°C. Suitable halogen electrodes were formed with each salt by the pulsed electrolysis current. The thermal stability of silver fluoride was studied. Upon melting under an inert atmosphere in a fused silica tube, a sample decomposed leaving metallic silver. No excessive decomposition of the other silver halides was observed in the electrochemical cell as high as 800°C. Dissert. Abstr.

N68-22211*# Monsanto Research Corp., Everett, Mass.

SEPARATOR DEVELOPMENT FOR A HEAT STERILIZABLE BATTERY Quarterly Summary Progress Report No. 5, 1 Jan.–31 Mar. 1968

John C. O'Connell, Elizabeth A. McElhill, and Carl A. Olson 31 Mar. 1968 15 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951524)
(NASA-CR-94322; MRB6234Q5) CFSTI: HC $3.00/MF $0.65 CSCL 10C

A 31:69 2-vinylpyridine-methyl methacrylate copolymer was selected as the separator material for large scale preparation. This polymer has excellent electrical properties after saponification and is adaptable for film preparation on paper coater. A sufficient amount of this polymer to make a total of 100 linear feet of 18-inch wide 1.5-mil film was prepared and purified. Procedures for making film on the paper coater were developed and 40 feet of film in sections with lengths up to 25 feet were made in initial runs. Methods to accelerate saponification of these copolymers during sterilization were studied. Some films that saponified completely within one 60-hour sterilization cycle were obtained by both pretreatment of copolymer films with methanol and by partial presaponification of the copolymer before film formation. Author

N68-22226*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ELECTRON RADIATION EFFECTS ON SILVER–ZINC CELLS
Charles F. Palandati Apr. 1968 13 p refs
(NASA-TM-X-63170) CFSTI: HC$3.00/MF$0.65 CSCL 10C

A test has been completed to determine the effects of electron irradiation on vented silver–zinc (Ag–Zn) cells, similar to the type used in the AE-B (Explorer 32) spacecraft. Irradiation by electrons of energies up to 1.5 Mev at 10^{15}e/cm^2 caused severe deterioration of the cellophane separator material, producing catastrophic cell failures. Half of the cells irradiated at 10^{14}e/cm^2 failed after being subjected to numerous charge–discharge cycles. No cell failures occurred at 10^{13}e/cm^2. Results also indicated that a cell's state of charge during irradiation may affect its ampere-hour capacity. Author

N68-22231*# Electro-Optical Systems, Inc., Pasadena, Calif.
PLANETARY SOLAR ARRAY DEVELOPMENT, VOLUME 3
Quarterly Report
R. Wizenick 15 Apr. 1968 86 p Prepared for JPL
(Contracts NAS7-100; JPL-952035)
(NASA-CR-94318; EOR-7254-Q-3, V. 3; QR-3) CFSTI: HC $3.00/MF$0.65 $0.65 CSCL 10B

Results from detailed structural, electrical, and system analyses are presented on a single-panel oriented array concept of a planetary photovoltaic solar array for operation on the Martian surface. The system consists basically of a four-section solar panel which is mounted universally on a vertically standing boom. The deployment and position mechanisms of the main antenna system are integrated with and driven through this same vertical boom assembly. This design provides for the solar panels being mounted in such a manner that three sides of the spacecraft are completely unobstructed. This allows the minimum number of circuits used (30) to achieve the required power output of 200W under worst case conditions. The single-panel oriented array of 30 circuits will meet the desired goal of 20 W/lb at 1 AU, and exceed the minimum power requirement of 200W. B.S.D.

N68-22232*# Electro-Optical Systems, Inc., Pasadena, Calif.
PLANETARY SOLAR ARRAY DEVELOPMENT, VOLUME 1
Quarterly Report
R. Wizenick 15 Apr. 1968 154 p Prepared for JPL
(Contracts NAS7-100; JPL-952035)
(NASA-CR-94320; EOS-7254-Q-3, V. 1; QR-3) CFSTI: $3.00 CSCL 10B

A detailed analysis is presented on a nontracking, deployed, truncated conical solar array for operation on the Martian surface. This system, after its release from the locked, launched and flight position, will require no power from the lander system for deployment or continuous operation for the mission life of one year. The packaging and deployment of the array are described, and details are given on the structural, electrical, and system analyses. Based on the various performance and evaluation tests, it is concluded that this system will not neet the desired goal of 20 W/lb at 1 AU, and under worst conditions be under the minimum power requirements of 200 W of electrical power at solar noon. B.S.D.

N68-22233*# Electro-Optical Systems, Inc., Pasadena, Calif.
PLANETARY SOLAR ARRAY DEVELOPMENT, VOLUME 2
Quarterly Report
R. Wizenick 15 Apr. 1968 105 p Prepared for JPL
(Contracts NAS7-100; JPL-952035)
(NASA-CR-94319; EOS-7254-Q-3, V. 2; QR-3) CFSTI: $3.00 CSCL 10B

Systems engineering analysis data are presented on a two panel oriented array for Martian surface operation. The design concept of the system minimizes the shadow problem without confining the antenna system with solar panels. This array, which has orientation capability, is a tradeoff against the antenna shadow problem in which the total array was sized at 40 circuits, instead of the minimum of 30 circuits required. This design provides for the solar panels being mounted on opposite sides of the spacecraft in such a manner that the other two spacecraft sides are always completely unobstructed, and there is no interference with the vehicle antenna system. The structural, electrical, and system analyses are discussed. Results from performance and evaluation tests show that this system will meet the desired goal of 20 W/lb at 1 Au and exceed the minimum power of 200W at solar noon for worst case conditions. B.S.D.

N68-22235*# Metals and Controls, Inc., Attleboro, Mass.
HEAT STERILIZABLE Ni–Cd BATTERY DEVELOPMENT
Quarterly Progress Report, 1 Oct.–31 Dec. 1967
E. J. Rubin and P. V. Popat 31 Dec. 1967 55 p Prepared for JPL
(Contracts NAS7-100; JPL-951972)
(NASA-CR-94315; QPR-2) CFSTI: $3.00 CSCL 10C

Optical microscopic studies reveal that during heat sterilization there is no marked corrosion of the nickel support structure although distinctive color and texture changes do occur at both electrodes. X-ray diffraction, porosity and pore size distribution data indicate changes occurring in the morphology or crystallography of the plates which may adversely affect electrolyte distribution and/or electrochemical efficiency of the cell. Several sealed rectangular cells have successfully passed two heat sterilization cycles and have delivered over 70% of their rated capacity. However, the charging mode of the heat sterilized cells needs to be optimized to avoid excessive voltage and pressure buildup, particularly during the first post-sterilization cycles. Author

N68-22257*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF REACTOR-LOOP TRANSIENTS DURING STARTUP OF A SIMULATED SNAP-8 SYSTEM
Pierre A. Thollot, Henry B. Block, and Kent S. Jefferies Washington May 1968 46 p refs
(NASA-TN-D-4546) CFSTI: HC$3.00/MF$0.65 CSCL 10B

Experimental investigations of primary-loop transients during the startup of a Rankine-cycle space-power system were conducted in the SNAP-8 Simulator Facility at Lewis. Of particular significance to these studies was the fact that both a realistic reactor simulator and a flight-weight mercury boiler were used in the primary loop. Furthermore, the system tested used the same liquid metals and operated at similar temperatures, pressures, and flow rates as those of the SNAP-8 system. During startup, the electric heater power input was automatically controlled so that the transient behavior of a real reactor could be duplicated. With the exception of this automic power control, all other variables were manually controlled to predefined values. In order to evaluate the relative merits of the wide variety of startup modes studied, a method of judging the results of each run was derived based on the reactor simulator exit temperature excursion. A comparison of this criterion with individual nuclear-system constraints showed excellent agreement. Author

N68-22258*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Hampton, Va.
THE GEOMETRIC PROPERTIES OF AN EXPANDABLE WHIRLING-MEMBRANE SOLAR-ENERGY CONCENTRATOR
John M. Jerke and Atwood R. Heath, Jr. Washington May 1968 36 p refs
(NASA-TN-D-4532) CFSTI: HC$3.00/MF$0.65 CSCL 10A

The whirling-membrane concept of solar-concentrator fabrication has been proposed for use with spacecraft-power-conversion devices because of its compact-packaging potential. Three membranes of 0.01-millimeter-thick aluminized plastic were constructed and attached to metal hubs for which the ratios of the hub radius to the membrane radius were 0.20, 0.35, and 0.50. The resulting models that had design focal lengths of 132.1 centimeters and design diameters of 3.05 meters were rotated at 71 radians per second in a vacuum chamber at pressures below 133 newtons per meter^2. The accuracy with which each membrane achieved the design paraboloidal shape was measured by an optical-ray-trace technique. The membrane with the metal hub of largest diameter gave the best concentration of energy. For this model, the focal length was 130.5 centimeters or 1 percent less than the design value. A geometric efficiency of 1.00 was obtained at a concentration ratio of 23. Membrane surface mean errors varied from −0.6° to 0.4° in the radial direction and were essentially zero in the circumferential direction. The random error has a standard deviation of 0.5° in the radial direction over most of the membrane and 0.25° in the circumferential direction. Location of supporting cables relative to the metal hub was found to be an important factor in the design of a whirling-membrane concentrator. Author

N68-22371# National Bureau of Standards, Washington, D. C.
DESIGNS FOR SURVEILLANCE OF THE VOLT MAINTAINED BY A SMALL GROUP OF SATURATED STANDARD CELLS
W. G. Eicke and J. M. Cameron 9 Oct. 1967 23 p refs
(NBS-TN-430) GPO: $0.20

This technical note describes a procedure for maintaining surveillance over a small group of saturated standard cells. The measurement process is briefly discussed and the principle of left–right balance as a means of eliminating certain systematic errors is developed. Specific designs and their analysis for intercomparing 3, 4, 5 and 6 cells in a single temperature controlled environment are given. Procedures for setting up control charts on the appropriate parameters are given, and a technique is described for detecting certain types of systematic errors. Author

N68-22377*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OVERCHARGE CONTROL OF NICKEL-CADMIUM SPACECRAFT BATTERIES USING THE AUXILIARY ELECTRODE SIGNAL
Floyd E. Ford Mar. 1968 31 p refs
(NASA-TM-X-63177; X-716-68-121) CFSTI: HC $3.00/MF $0.65 CSCL 10C

The auxiliary electrode is a flight-qualified charge-control device that signals the onset of overcharge within a sealed nickel-cadmium cell. Being in intimate association with the electrochemical process of the nickel-cadmium cell, it provides a unique method for overcharge control. Qualification of the 20-ampere-hour cell with auxiliary electrode for the OAO spacecraft has shown that no compensation of the electrode signal is required for the temperatures, charge rates and depths of discharges experienced by the batteries on this spacecraft. A study of the effectiveness of charge-control signals from 100 to 500 millivolts with 47-ohm impedance between the auxiliary and negative electrode established a 250- to 300-millivolt range as an optimum control level. Characteristics observed with this control level include less than one-atmosphere cell pressures and 1-watt or less thermal dissipation from overcharge. Results of this study have shown that optimum performance obtained with this control level can be achieved only when the battery ampere-hour capacity is not maximized by overcharge. Author

N68-22706*# Bureau of Mines, Pittsburgh, Pa. Pittsburgh Coal Research Center.
DEVELOPMENT OF AN IMPROVED OXYGEN ELECTRODE FOR USE IN ALKALINE H_2O_2 FUEL CELLS Quarterly Report, Jan. 1–Mar. 31, 1968
31 Mar. 1968 8 p
(NASA Order W-12300)
(NASA-CR-94352, Q-7) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Brief descriptions are presented for those combinations of reduced, mixed metals prepared in the synthesis of interstitial compounds used for increasing the efficiency of the oxygen electrode in alkaline H_2–O_2 fuel cells. The electrochemical activity of various catalysts in the reduction of O_2 is tabulated. E.J.S.

N68-22811*# Allis-Chalmers Mfg. Co., Milwaukee, Wis. Advanced Electrochemical Products Div.
FUEL CELL RELIABILITY ASSESSMENT Quarterly Report, 8 Jan.–8 Apr. 1968
R. P. Bruno May 1968 18 p
(Contract NAS8-2696)
(NASA-CR-94426; NAS-8-2696-QPR-2004) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Efforts to determine fuel cell stack performance under high stress conditions and to establish reliable operating limits were continued. All testing of Stacks 136, 137, and 138 was completed. Endurance testing of Stack 196 was terminated because of a reduction in operating temperature to 135°F. Stack 197 completed its acceptance test. Stack 198 was vacuum loaded and is being maintained in its present condition at room ambient awaiting further testing. DVT Module S/N 17 was assembled and acceptance tested. A temperature sensing malfunction was noted. The module was repaired and retested. R.N.A.

N68-22840# Minnesota Mining and Mfg. Co., St. Paul, Minn.
SNAP-23A PROGRAM. THERMOELECTRIC CONVERTER DEVELOPMENT PROGRAM, PHASE 1 Quarterly Report, 1 Jul.–30 Sep. 1967
J. V. Wachenheim 30 Sep. 1967 91 p refs
(Contract AT(30-1)-3824)
(MMM-3824-0013; QR-3) CFSTI: HC $3.00/MF $0.65

The first four 10-couple modules were assembled and placed on long-term performance test and assembly was started for Experimental Mockup Converter number 1. Converter/system thermal interface definition was established. A design requirement specification was prepared for the Experimental Mockup Converter performance. Converter test plans and procedures were prepared. Thermoelectric material recharacterization was initiated. The 10-couple module test plan was submitted. Process and test stations (converter and 10-couple module) assembly are ninety percent complete. NSA

N68-22842*# Bendix Corp., Davenport, Iowa.
DEVELOPMENT OF A LIQUID SHROUD CRYOGENIC SUPERCRITICAL PRESSURE STORAGE SYSTEM
Washington NASA May 1968 66 p refs
(Contract NAS9-4634)
(NASA-CR-1048; Rept.-3734A-67) CFSTI: HC $3.00/MF $0.65 CSCL 13A

The concept of insulating a cryogenic fluid by the vaporization of a secondary cryogenic refrigerant is not new. This technique has been used for several years in ground equipment and laboratory type liquid helium dewars. However, little effort has previously been expended in applying this technique to flight-type equipment. Fuel cell reactants supply systems, environmental control systems, and propellant pressurization systems to be utilized aboard future spacecraft will all require improved state-of-the-art advances in the handling and storage of cryogenic fluids. The concept of shroud cooling of a cryogenic storage system is discussed in this report to determine the potential weight savings and improved thermal performance for certain applications. In addition, vapor cooling of a discrete radiation shield for more effective insulation is discussed. The cryogenic shroud system fabricated and tested in this program is described. The feasibility of this cryogenic storage system for specific flight applications has been successfully demonstrated by this program. Author

N68-22889*# Esso Research and Engineering Co., Linden, N. J. Government Research Lab.
FEASIBILITY STUDY OF HIGH PERFORMANCE HYDROGEN-OXYGEN FUEL CELLS Final Technical Report
Eugene H. Okrent, Martin Lieberman, and Carl E. Heath Dec. 1967 123 p refs
(Contract NAS7-529)
(NASA-CR-94407; GR-1-HOF-67) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Two process concepts were examined to determine if decoupling the limiting cathodic process into its own reaction space could result in increased hydrogen-oxygen fuel cell efficiency and result in enhanced specific power. Although decoupling was successful with slurry catalyst and mediator systems, the anticipated performance improvements were not obtained. Analysis of the slurry systems indicated that the moving bed concept introduced excessive parasitic pumping losses which significantly reduce power density and efficiency even under "idealized" conditions. The mechanical slurry system gave somewhat better results, yielding a specific power of 25 lb/kw. However, the overall efficiency was 53 percent, significantly below that of comparable conventional systems. Work on the mediator concept indicated that the stack had good current capability, but the scrubber regenerator introduced a significant weight debit. Even with projected system improvements the best specific power obtained (500 lb/kw) is at least an order of magnitude poorer than conventional systems. Author

N68-22908*# Electric Storage Battery Co., Yardley, Pa. Carl F. Norberg Research Center.
HEAT STERILIZABLE, IMPACT RESISTANT CELL DEVELOPMENT Quarterly Report, 1 Oct.–31 Dec. 1967
G. W. Bodamer, ed. 14 Mar. 1968 66 p Prepared for JPL
(Contracts NAS7-100; JPL-951296)
(NASA-CR-94404; QR-4) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Impact specifications have been changed to require survival of shock at 2800±200 "g" from a velocity of 115±3 ft./sec. In addition, new heat sterilizable battery capabilities have been required and can be summarized. A prolonged low current pre-formation charge virtually eliminates the pressure build-up previously encountered during formation. A partial discharge followed by recharge at the end of normal charge increases capacity 15%. This technique, however, is not sufficient to overcome capacity losses which follow sterilization of sealed cells and which run between 20 and 60%. Five amp-hr sealed cells with silver sheet electrode reinforcement have survived 2000 to 2400 "g" shocks but show a 30% loss in capacity thereafter; however, the loss is recovered upon recharging. Author

N68-22934# Atomics International, Canoga Park, Calif.
S8DR ACTUATOR Interim Report
W. G. Long 30 Dec. 1967 35 p refs
(Contract AT(04-3)-701)
(NAA-SR-12605) CFSTI: HC $3.00/MF $0.65

The design of the SNAP-8 Prototype System rotary actuator is given. Control drum requirements are listed. Results of performance testing are tabulated; the performance is evaluated. Actuator environmental design criteria are given. Problem areas are outlined. NSA

N68-22974# United Kingdom Atomic Energy Authority, Harwell (England).
THERMOELECTRICITY: A STATUS SURVEY
G. E. Hare Jul. 1966 16 p refs
(AERE-M-1768) CFSTI: HC $3.00/MF $0.65

In recent years thermoelectricity has developed from a convenient method of temperature indication to being the basis of new systems for power generation and heat pumping. It seems likely that in the near future many people will be considering the potential of these new devices in their own fields, and since they will probably be unfamiliar with the technology involved, an attempt is made to provide a quick introduction covering the physical phenomena, simple design procedures, and the present "state of the art." Thermomagnetic phenomena such as the Nernst, Ettingshausen, and Reghi–Leduc effects are not considered, but there is some mention of the recent work on the enhancement of thermoelectric properties in the presence of magnetic fields. Author (NSA)

N68-22983# Commissariat a l'Energie Atomique, Saclay (France).
FAST LIBERATION OF ENERGY STORED USING SUPERCONDUCTORS [LIBERATION RAPIDE D'ENERGIE STOCKEE AU MOYEN DE SUPRACONDUCTEURS]
Gerard Prost and Jean Sole Nov. 1967 45 p In FRENCH; ENGLISH summary
(CEA-R-3255) CFSTI: HC $3.00/MF $0.65

After a rapid description of the circumstances in which they first thought of using superconducting materials for the storage and liberation of energy, the authors examine, in comparison to condensers, the energy densities which can thus be stored, the methods used for introducing this energy into the superconducting circuit and for trapping it, and the law governing the discharge of this energy into a purely dissipative impedance. This leads to a derivation of the expression for the energy yield which depends on the characteristics of the switch used for opening the superconducting switch with a view to understanding the various parameters. As a result of this analysis, transitions of this switch, over the whole of its mass, were obtained for periods of a few microseconds, and energy yields close to unity were obtained. The obtention of fast discharges is now no longer a technological problem. Author

N68-22991*# Thermo Electron Engineering Corp., Waltham, Mass.
SOLAR THERMIONIC GENERATOR DEVELOPMENT Quarterly Report, 1 Dec. 1967–29 Feb. 1968
Apr. 1968 35 p Prepared for JPL
(Contracts NAS7-100; JPL-951263)
(NASA-CR-94402; TE4055-145-68; QR-9) CFSTI: HC $3.00/MF $0.65 CSCL 10B

During this quarter, the fabrication and test of converter T-208 have been completed. This model is the first under this program to incorporate a collector-radiator heat pipe structure. The dynamic performance of converter was almost identical to that of model T-207 in spite of a 17% reduction in collector area, but the failure of the static data to reproduce the performance data obtained dynamically has shown that the collector of converter T-208 operates at an excessive temperature. The cause of the high collector temperature is believed to be the limited area for vapor flow available at one component of the heat pipe, and it will be corrected in the construction of the following model. In addition, the performance of converter T-208 was relatively low, and cesium conduction tests revealed an unusually large spacing of about 4.4 mils; steps will be taken to improve the positioning of parts during assembly of T-209. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N68-21952# Brookhaven National Lab., Upton, N. Y.
FUNDAMENTAL RADIOBIOLOGY FOR THE HIGH-ENERGY ACCELERATOR HEALTH PHYSICIST
Victor P. Bond, J. S. Robertson, Tor Brustad, Sheldon Wolff, G. W. Barendsen et al *In* AEC On the Biol. Interpretation of Dose from Accelerator-Produced Radiation 16 Mar. 1967 p 1–14 refs (See N68-21951 12-06)

Evaluation and interpretation of the radiation environment around higher energy accelerators was studied by the following experiments: (1) *Cellular Radiobiology in the Mammal*—radiobiological principles for predicting radiation effects in cells; (2) *Basic Physical Mechanisms in Radiobiology*—physicochemical mechanisms in ionizing radiation interactions with absorbing material; (3) *Effects of Accelerated Heavy Ions on Enzymes in the Dry State and in Aqueous Solutions*—inactivation of enzymes by radiation; (4) *Chromosome Damage*—radiation induced gene mutations; (5) *Fundamental Aspects of the Dependence of Biological Radiation Damage in Human Cells on the Linear Energy Transfer of Different Radiations*—quantitative effectiveness differences between various cell irradiations; (6) *Fractional Linear Energy Transfer*—local density of energy deposition along the path of an ionizing particle; and (7) *Tissue, Organ, and Organism Effects*—radiation effects on cell-renewal system after total body exposure to X-rays. G.G.

N68-21953# Oak Ridge National Lab. Biology Div.
SOMATIC AND GENETIC EFFECTS IN ANIMALS AND HUMANS
W. L. Russell, Howard Parker, Clarence Lushbaugh, J. F. Fowler, Leonard A. Sagan et al *In* AEC On the Biol. Interpretation of Dose from Accelerator-Produced Radiation 16 Mar. 1967 p 81–87 refs (See N68-21951 12-06)

Reported studies on radiation effects in animals and humans are: (1) *Recent Studies on the Genetic Effects of Radiation in Mice*—radiation factors that affect mutation frequency; (2) *Data from Various Occupational Groups*—summary of radiation accident history at Lawrence Radiation Laboratory; (3) *Some Biological End Points of Dosimetric Value Derived from Clinical Data*—clinical biological responses for radiation dosage appraisal; (4) *Effects of Total- and Partial-Body Therapeutic Irradiation in Man*—results from total- and partial-body exposure of human beings to radiation and implications for workers in accelerators; (5) *Data from Animal Experiments*—somatic radiation damage in the skin of pigs, mice, and rats after irradiation with cyclotron neutrons; (6) *Recent Studies Among Persons Exposed to Radiation from Military or Industrial Sources; A Review;* (7) *Dosimetry and RBE at the Ends of Proton Trajectories*—trajectory end effects of broad proton beams near accelerators and in space flight; (8) *Relative Biological Effectiveness of Rays, X-Rays, Protons, and Neutrons for Spermatogonial Killing*—biological effectiveness of different types of radiation on mouse spermatogonia; and (9) *Intestinal and Gonadal Injury After Exposure to Fission Neutrons*—relative radiosensitivity of gastrointestinal tract and reproductive organs as specific indicators for neutron irradiation. G.G.

N68-21954# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
THE CONTRIBUTION OF BIOLOGY TO STANDARDS OF RADIATION PROTECTION
Samuel M. Nabrit *In its* on the Biol. Interpretation of Dose from Accelerator-Produced Radiation 16 Mar. 1967 p 192–196 (See N68-21951 12-06)

Briefly reviewed are the biological effects of various forms of radiation used in clinical and diagnostic medicine. Aspects of disease therapy, radiation induced mutations, and the concept of cellular repair mechanisms are outlined with emphasis on radiation dose, dose rate, and biological effectiveness. G.G.

N68-21955# California Coll. of Medicine, Los Angeles.
PHYSICAL FACTORS IN RADIATION PROTECTION
Charles A. Sondhaus, Howard Maccabee, Stanley B. Curtis, R. D. Birkhoff, George R. Holeman et al *In* AEC On the Biol. Interpretation of Dose from Accelerator-Produced Radiation 16 Mar. 1967 p 197–220 refs (See N68-21951 12-06)

Physical measurements on high-energy charged particles to specify the dose distribution within tissue in both space and time. In order to characterize radiation exposure completely, the following five quantities are determined: (1) the accumulated absorbed dose; (2) the dose rate time profile; (3) the fraction or region of the body which has been exposed; (4) the depth-dose distribution; and (5) the energy density or any other information which characterizes the nature of the local energy distribution. Experiments with gamma irradiated and proton irradiated primates seem to establish a higher proton effectiveness in white blood cell depression; however, in terms of the absorbed dose at the midline of the animal the proton exposure, due to the buildup of secondaries, had the effect of reversing the apparent effectiveness ratio. Also described are various other studies on ionization fluctuations in cells and dose equivalent and fractional cell lethality calculations. G.G.

N68-21956# California Univ., Los Angeles. Dept. of Radiology.
NEW DEVELOPMENT AND RECENT EXPERIENCE
Norman A. Baily, Cornelius A. Tobias, Chaim Richman, Jose M. Feola, and Amos Norman *In* AEC On the Biol. Interpretation of Dose from Accelerator-Produced Radiation 16 Mar. 1968 p 329–345 refs (See N68-21951 12-06)

Research activities discussed are: (1) *Recent Results in Macro and Micro Dosimetry of High-Energy Particulate Radiation*—methodology and instrumentation for evaluating spectral data, particle analysis, and flux measurements for biological or health physics purposes; (2) *Negative Pi Mesons, Radiobiology, and Cancer Therapy*—biological experiments and dosimetric techniques with pion beam irradiation; (3) *A Review of the Physical Characteristics of Pion Beams;* (4) *Pion Radiobiology*—cytological studies with negative pions; and (5) *Use of Chromosome Aberrations for Dosimetry*—radiation dose estimates from chromosome aberration frequency in lymphocytes. G.G.

N68-22006 St. Louis Univ., Mo.
EVIDENCE FOR A DUAL CUTANEOUS VASOMOTOR CONTROL
Leon Donald Prokop (Ph.D. Thesis) 1966 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-2964

Dual vasomotor control of cutaneous blood vessels, with emphasis on the existence of a neural vasodilator mechanism in the control of forearm cutaneous vasculature, was studied by a pharmacological approach in which selective peripheral blockade of the adrenergic and cholinergic nervous systems was accomplished by classical sympatholytic and parasympatholytic agents. Control and experimental skin areas on the dorsal forearm surface of human subjects were selected for experimentation. All experiments were performed at normal ambient temperatures. Solutions of the adrenolytic and cholinolytic drugs were administrered into the experimental skin areas in specific concentrations by iontophoresis. Physiological stimulation of the autonomic nervous system demonstrating cutaneous vasomotor responses was accomplished by cold stimulation of the contralateral hand and forearm. Dissert. Abstr.

N68-22026*# Research Triangle Inst., Durham, N. C. Engineering and Environmental Sciences Div.
BIOMEDICAL APPLICATIONS TEAM Quarterly Progress Report, 15 Dec. 1967–14 Mar. 1968
14 Mar. 1968 104 p refs
(Grant NSR-34-004-045)
(NASA-CR-94295; QPR-3) CFSTI: HC $3.00/MF $0.65 CSCL 06B

The transfer of aerospace science and technology to the biomedical field is described in terms of the activities of three multidisciplinary biomedical applications teams. The efforts expended in matching problems existing in biological and medical research programs with technology developed in NASA's research and development programs are discussed. Summary data are provided on completed transfers of technology and potential transfers which seem promising, and methods of increasing the effectiveness of the program are evaluated. Also included are six biomedical problem abstracts which are prepared for dissemination through the Technology Utilization Division to the NASA centers and other participating organization; the aim is to uncover information pertinent to a solution. These relate to thermograms of the oral cavity, small sensor measurements of surface temperature of human teeth, a bacteria sampling technique, subglottal pressure measurements, an electrode for measuring hydrogen ion concentration and carbon dioxide partial pressure in the blood, and a blood vessel constrictor. A bibliography is included. M.G.J.

N68-22045*# National Aeronautics and Space Administration, Washington, D. C.
FOOD FOR SPACE FLIGHT
1968 8 p
(NASA Facts NF-41/12-67) GPO: HC $0.20; CFSTI: MF $0.65 CSCL 06H

Presented is a brief survey on food requirements of manned space flights for Project Mercury, the Gemini Program, and the Apollo programs. Because of obvious weight and space limitations, emphasis is placed on light weight with minimal storage requirements and no refrigeration. Meal components are consumed directly from sealed containers due to conditions of weightlessness during flights. Thus, special procedures for preparing, packaging, and storing food are developed and implemented and examples of food and hardware used are shown graphically. Nutritional studies indicate that approximately 2680 calories per day are required for subjects weighing about 68 kg and a proportionally greater number for heavier subjects. G.G.

N68-22194*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY—A CUMULATIVE INDEX
Jan. 1968 887 p refs Supersedes NASA-SP-7011(45)
(NASA-SP-7011(46); NASA-SP-7011(45)) CFSTI: HC $3.00/MF $0.65 CSCL 06S

This publication is a cumulative index to the past twelve issues (SP-7011(34) through SP-7011(45)) of the National Aeronautics and Space Administration's Continuing Bibliography titled *Aerospace Medicine and Biology*. The bibliography has been compiled through the cooperative efforts of the Aerospace Medicine and Biology Bibliography Project of the Library of Congress (LC), the American Institute of Aeronautics and Astronautics (AIAA), and the National Aeronautics and Space Administration (NASA). Entries prepared by the three contributing organizations are identified as follows: (1) NASA entries by their STAR accession numbers (N67-10000 series); (2) AIAA entries by their IAA accession numbers (A67-10000 series); and (3) LC entries identified by a number in the A67-80000 series. Author

N68-22210*# Techtran Corp., Glen Burnie, Md.
ALIMENTARY BEHAVIOR AND ORGANIC ADAPTATION TO DESERT ZONES [COMPORTEMENT ALIMENTAIRE ET ADAPTATION ORGANIQUE EN ZONE DESERTIQUE]
Rene Henane Washington NASA Apr. 1968 21 p refs Transl. into ENGLISH from Rev. Corps Sante Armees (Paris), v. 4, 1963 p 33–54
(Contract NASw-1695)
(NASA-TT-F-11612) CFSTI: HC $3.00/MF $0.65 CSCL 06P

A brief description of the climate of the Sahara is followed by a detailed description of the diet of the nomadic Meharists. Religion and custom as well as practical expediency are discussed as reasons for the selection of such imbalanced eating habits. A detailed analysis of the nutritional value and substantial deficiencies offered by the diet are shown to be basic to this native group's adaptation ability to the torrid desert climate. Other tests on both man and animals are discussed and compared in terms of validity and accuracy. Author

N68-22252*# Techtran Corp., Glen Burnie, Md.
ON THE EFFECT OF EXTERNAL CONDITIONS ON THE DEVELOPMENT OF FROG EGGS
O. Hertwig Washington NASA May 1968 7 p Transl. into ENGLISH from the book "Uber Den Einfluss Ausserer Bedingungen auf die Entwickelung des Froscheies" Berlin, Sitzungbericht, vol. 1, 1894 p 311–317
(Contract NASw-1695)
(NASA-TT-F-11676) CFSTI: HC $3.00/MF $0.65 CSCL 06C

The effects of temperatures and saline solutions on the eggs of *Rana fusca* are investigated. The eggs develop normally but at an accelerated rate up to 25°C. Higher temperatures retard or halt the developmental process, starting in the vegetative portion. Cooling produces similar results. Saline solutions (6–10 g $NaCl//H_2O$) also attacked the vegatative portion of the eggs first. NaCl solutions produced brain damage in frogs (hemicephalia). Author

N68-22288 Joint Publications Research Center, Washington, D. C.
BASAL METABOLISM IN ANIMALS IN CONNECTION WITH THE NEGENTROPY PRINCIPLE OF INFORMATION
A. I. Bykhovskiy *In its* Some Spec. Appl. of Cybernetic Tech. 6 May 1968 p 11–17 refs (See N68-22285 12-10)

A living organism and its environment are considered as an isolated system to study the relationship between animal basal metabolism and the "negentropy" principle of information flow. The animal is considered to be at physiological rest, and the dependence of basic exchange on animal mass is shown for both warm-blooded animals and fresh water fish. Certain thermal values are greater for the former group. Studies in which the largest animals of certain species of animals do not show dependence of metabolism on mass indicate these animals perish. M.W.R.

N68-22442*# Sandia Corp., Albuquerque, N. Mex. Systems Studies Div.
A SYSTEMS APPROACH TO CONTAMINATION CONTROL
C. A. Trauth, Jr. Apr. 1968 38 p refs
(NASA Order R-09-019-040)
(NASA CR-94357; SC-M-68-235) CFSTI: HC $3.00/MF $0.65 CSCL 06F

Contamination control is still a subject suffering from a lack of cohesiveness because their is no theory which applies to all specific control problems and encompasses all types of contamination control techniques. This paper represents an attempt to formulate a framework in which such a theory may be developed. In effect, this is a framework in which contamination control can be planned for on a cost-effectiveness basis. Author

N68-22443# Naval Scientific Technical Information Center, London (England).
CHARACTERISTICS OF NEUTRONS AND NEUTRON SOURCES WITH REGARD TO BIOLOGICAL APPLICATIONS
Y. van der Feer 1967 16 p Transl. into ENGLISH from Atoomenergie Haar Toepassingen (Rotterdam), Jun. 1966 p 122–129
(NSTIC-TRANS-1840) CFSTI: HC $3.00/MF $0.65

Briefly described are some general properties and functions of the following: (1) interaction of neutrons with biological materials; (2) thermal and intermediate neutrons; (3) fast and relativistic neutrons; (4) production of neutrons and practical radioactive sources; and (5) use of accelerators and nuclear reactors. K.W.

N68-22476# National Research Council of Canada, Ottawa (Ontario).
BIOLOGICAL EFFECTS OF RARE, DISPERSED AND OTHER METALS AND THEIR COMPOUNDS USED IN INDUSTRY
S. E. Sandratskaya 1967 15 p refs Transl. into ENGLISH from Toksikol. Redkikh Metallov Medgiz (Moscow), 1963 p 117–135
(NRC-TT-1283) CFSTI: HC $3.00/MF $0.65

In view of the increasing use of tellurium in industry, a comprehensive study of the toxic effect of tellurium and its dioxides was undertaken. Details are given on the study which include: (1) a study of the relative toxicity of various industrial aerosols of tellurium and its dioxides in relation to their chemical composition and dispersity; (2) a study of the principle manifestations and the individual aspects of the mechanism of the toxic effect of tellurium, and determination of the approaches to the establishment of a limit to the amount of these substances in the air in industrial premises. The experimental studies comducted to determine these properties of tellurium are described, and the results are delineated. From the results obtained in this work, it is recommended that preventative and periodical medical examinations be carried out at all plants connected with the production or use of tellurium or its compounds.
B.S.D.

N68-22520*# Avco Corp., Lowell, Mass. Space Systems Div.
A STUDY OF CHEMICAL RESIDUES LEFT ON SURFACES AFTER BIOLOGICAL ASSAY PROCEDURES, PHASE 2
W. Gillchriest 15 Aug. 1967 20 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951624)
(NASA-CR-94372; AVSSD-0318-67-CR) CFSTI: HC $3.00/MF $0.65 CSCL 06T

An evaluation of the chemical residue left on the CMTM hardware after bioassay showed peptone deposits from the three liquid methods—swabbing, rinsing, and washing. The washing method also left the detergent, Tween 80, detected by ultraviolet radiation fluorescence when combined with phosphine 3R. The two solid methods, lift-off tape and rodacing, left residuals on the hardware which were removable with organic solvents. The rodacing method did not leave residual chloride. The peptone residue was considered the least desirable from a biological burden viewpoint. Tween 80 is considered less of a biological burden problem then peptone.
Author

N68-22522*# Avco Corp., Lowell, Mass. Space Systems Div.
STERILIZATION ASSEMBLY DEVELOPMENT LABORATORY. A STUDY OF THE MICROBIAL BURDEN ACCUMULATED ON ASSEMBLIES BUILT IN EASL UNDER DISRUPTED VERTICAL AIRFLOW
E. M. Hajema 15 Aug. 1967 35 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951624)
(NASA-CR-94339; AVSSD-0319-67-CR) CFSTI: HC $3.00/MF $0.65 CSCL 06T

Experiments were conducted to determine the effects of disrupting laminar downflow on the microbial burden accumulated on hardware assemblies. A 30° aluminum cone, 6 ft in diameter and 3 ft high, was used to demonstrate the disruption under conditions of the normal assembly facility environment; assembler and worktable under center of the cone; and assembler under cone with worktable under edge of cone, and also with the horizontal laminar airflow directed over the worktable toward the assembler. The microbial burden of the intramural air was monitored by Reynier samples; Rodac plates recorded the surface burden on the worktable; fallout strips determined the viable particles/ft^2 of surface; and stainless steel coupons inside the cone measured the microbial burden based on the air flow pattern. Data are included on the microbial counts from the timer parts assay groups, and the statistical relationships among the intramural air microbial burden samples under each set of environmental conditions. The findings show that the microbial burden of the intramural air was significantly increased during the assemblies carried out under all the experimental conditions of disrupted vertical laminar downflow.
M.G.J.

N68-22523*# Avco Corp., Lowell, Mass. Space Systems Div.
STERILIZATION ASSEMBLY DEVELOPMENT LABORATORY. DEVELOPMENT OF PROCEDURES FOR ESTIMATING THE CMTM MICROBIAL BURDEN
30 Sep. 1967 316 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951624)
(NASA-CR-94338; AVSSD-0378-67-CR) CFSTI: HC $3.00/MF $0.65 CSCL 06T

Literature studies of spacecraft biological burdens, assay techniques, and assembly procedures were conducted as a basis for establishing terminal sterilization treatment requirements. An evaluation of the swab, Rodac, lift-off, rinsing, and washing techniques indicated that washing with a surfactant reagent was the most efficient method for determining microbiological surface burdens. The factors influencing the microbial burden on various capsule mechanical training model (CMTM) subsystem assemblies are defined, and approaches for estimating the load are detailed. The probabilities of sterility for the various CMTM subassemblies following flight acceptance (FA) and/or type approval (TA) sterilization cycles are presented. Techniques, procedures, and plans are developed for estimating the microbial load at any state of CMTM assembly and prior to terminal sterilization. Statistical verification and an analysis plan are included. Supporting data are presented on assembly procedures, and coupon disposition, location, and removal. A project management scheduled is proposed.
M.G.J.

N68-22529*# Texas Inst. for Rehabilitation and Research, Houston.
AN EVALUATION OF INTERMITTENTLY INFLATED EXTREMITY CUFFS IN PREVENTING THE CARDIOVASCULAR DECONDITIONING OF BEDREST AND WATER IMMERSION
Fred B. Vogt Apr. 1967 120 p refs
(Contract NAS9-5821; Grant NIH FR-00254)
(NASA-CR-92085) CFSTI: HC$3.00/MF$0.65 CSCL 06S

Intermittently inflated extremity cuffs were tested on healthy subjects to establish their effects in preventing cardiovascular orthostatic instability and body weight changes during total water immersion and bedrest studies. Body weight, fluid intake, urine output, and leg circumference measurements as well as analyses of the hematopoietic human system after tilt table intolerance studies in water immersion experiments and after prolonged bed rest periods showed that the extremity cuffs did not afford significant protection against cardiovascular deconditioning. The use of pressure garments on the lower extremities provided a statistically significant protective effect against the manifestations of cardiovascular deconditioning.
G.G.

N68-22531*# Avco Corp., Lowell, Mass. Space Systems Div.
EXPERIMENTAL ASSEMBLY AND STERILIZATION LAB: IDENTIFICATION OF MICROBIOLOGICAL ISOLATES
E. A. Botan 15 Apr. 1967 30 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951624)
(NASA-CR-94337; AVSSD-0128-67-CR) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Eighty-three isolates from the Experimental Assembly and Sterilization Laboratory were assayed for their morphological and biochemical characteristics. Of the total, 90.4 percent were gram-positive aerobic spore formers of the genus *Bacillus*, and 9.6 percent were gram-positive aeroboc cocci, members of the genus *Micrococcus* and *Staphylococcus*, plus a Gram variable organism, *Arthrobacter*. The presence of the latter was attributed to soil particles. *Staphylococcus* aureus variety *albus* and *epidermis* seem to stem from considerable shedding of skin particles and microorganism from uncovered face and neck areas; gowning of the workers was not completely effective in controlling skin shedding contamination. Tables of all identified microbiological characteristics and species are included.
G.G.

N68-22532*# Avco Corp., Lowell, Mass. Space Systems Div.
DETERMINATION OF THE HEAT RESISTANCE OF MICROBIAL ISOLATES FROM THE EASL
H. de L. King 15 Apr. 1967 35 p ref
(Contract NAS7-100; JPL-951624)
(NASA-CR-94340; AVSSD-0148-67-CR) CFSTI: HC $3.00/MF $0.65 CSCL 06M

The dry heat resistance of representative bacterial spores isolated from the Experimental Assembly and Sterilization Laboratory environment was assayed at 125°C when plated onto stainless steel strips. Biological assay date after exposure from 5 to 50 minutes in a hot air oven were reduced by weighted least-square procedure to the D value, or time required for a factor of 10 reduction in the number of organisms. Obtained D-values for *Bacillus globigi, Bacillus megaterium*, and *Bacillus pumilus* showed a wide range; these value variations were attributed to cellular physiological differences between the various organisms of the same subspecies. G.G.

N68-22556# Joint Publications Research Center, Washington, D. C.

CERTAIN PECULIARITIES OF THE PHYSIOLOGICAL REACTIONS OF PILOTS WHILE IMITATING A SPACE WALK

D. G. Maksimov, Ye. M. Peshkov, I. A. Skiba, and A. Ye. Uglov 30 Apr. 1968 20 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), 1967 p 682–693
(JPRS-45211) CFSTI: HC$3.00/MF$0.65

Physiological reactions of pilots undergoing training for space flights and persons without such training were analyzed upon leaving the simulated spacecraft and entering a very rarefied atmosphere. Pronounced shifts in pulse rates, respiratory rates, body weights, and temperatures were found among commanders; and, as the tests were repeated, the degree of shifts diminished sharply. In copilots, the shifts of physiological functions were more pronounced than in commanders and were associated with physical stress and nervous and emotional strain. Pilots who had undergone training for space flight reacted better than personnel who had not. Changes observed were of a temporary functional nature and generally disappeared by the end of the experiments. M.W.R.

N68-22577*# IIT Research Inst., Chicago, Ill. Technology Center.

EFFECTS OF SPACE CABIN ENVIRONMENTS ON INFECTION Final Report, 19 Jul. 1965–18 Sep. 1966

Bernard J. Mieszkjc and Richard Ehrlich Oct. 1966 39 p refs
(Contract NAS9-4978)
(NASA-CR-62065; IITRI-L6031-14) CFSTI: HC $3.00/MF $0.65 CSCL 06F

The effects of a simulated space cabin environment of 27,000-ft altitude (5 psi), 98% oxygen atmosphere, 25°C, and 50% relative humidity on the resistance of mice to infection were studied. Mortality rates were determined after challenge with *Klebsiella pneumoniae* aerosols and following exposures of various duration to space cabin environment, ambient conditions, and combinations of these two. In addition, mortality rates and effectiveness of treatment were determined after *Staphylococcus aureus* infection and following various combinations of exposure to space cabin environment and dosages of 300 to 500 rads of gamma radiation. The study included examination for changes in hemoglobin, hematocrit, lactic acid dehydrogenase isoenzyme patterns, histopathological characteristics, and differential blood cell count. K.W.

N68-22635*# Avco Corp., Lowell, Mass. Space Systems Div.

EXPERIMENTAL ASSEMBLY AND STERILIZATION LAB. MICROBIOLOGICAL ASSAY AND CERTIFICATION OF SPACECRAFT HARDWARE STERILITY: JPL PROCEDURE EASL 300.01

E. A. Botan 15 Apr. 1967 30 p refs Prepared for JPL Supersedes JPL Proc. EASL 300.00
(Contracts NAS7-100; JPL-951624)
(NASA-CR-94379; AVSSD-0134-67-CR) CFSTI: HC $3.00/MF $0.65 CSCL 06T

Procedures are established for performing microbiological assays and for certifying spacecraft hardware sterility. Personnel, equipment, and instrumentation requirements are listed, and safety standards are defined. Also covered are the calibration of air sampling devices; sample preparation; and the preparation and sterilization of microbial fallout sampling surfaces, culture media, and laboratory equipment. Test methods are outlined for microbiological samplings of intramural air, environmental surfaces, spacecraft hardware, clothing and packaging material, and personnel; total airborne particle counting; visual assays; recording parametric measurements; and quality assurance. The characteristics of volumetric air sampling and gravimetric air sampling devices are discussed. M.G.J.

N68-22680*# Avco Corp., Lowell, Mass. Space Systems Div.

STUDY OF CHEMICAL GERMICIDES

E. A. Botan and T. H. Rider 15 Apr. 1967 19 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951624)
(NASA-CR-94380; AVSSD-0133-67-CR) CFSTI: HC $3.00/MF $0.65 CSCL 06T

In an effort to determine spacecraft sterilization techniques, the effectiveness of several chemical germicides as decontaminating agents was assessed. These included the use of a cationic surfactant in aqueous and alcoholic solution, a phenolic compound, and a chlorinated phenol against *Escherichia coli, Staphylococcus epidermidis, Proteus vulgaris*, and *Bacillus globigii* in the vegetative and spore states. The materials were chosen to simulate surfaces in low biological-burden areas. Tabulated data on the kill effectiveness of each germicide are included. The results show that the only organism that survived in numbers greater than 10% of its initial population with all four germicides was the spore of *B. globigii*. M.G.J.

N68-22681*# Avco Corp., Lowell, Mass. Space Systems Div.

EXPERIMENTAL ASSEMBLY AND STERILIZATION LAB. PROCESS SPECIFICATION FOR DECONTAMINATION OF COMPONENT PARTS, TOOLS AND EQUIPMENT: JPL PROCEDURE EASL 200.01

E. A. Botan 15 Apr. 1967 14 p Prepared for JPL Supersedes JPL Proc. EASL 200.00
(Contracts NAS7-100; JPL-951624)
(NASA-CR-94356; AVSSD-0132-67-CR) CFSTI: HC $3.00/MF $0.65 CSCL 06T

Detailed procedures are established on the methods to be used before and after decontamination for the handling, transfer, and storage of items used in the fabrication of flight hardware in the EASL. Six decontamination categories are defined, with dry heat and ethylene oxide decontamination techniques identified as the preferred methods. Procedures for the preparation and packaging of items are outlined, along with decontamination effectiveness test requirements and ways of handling contaminated items. Quality assurance provisions are also defined. M.G.J.

N68-22682*# Avco Corp., Lowell, Mass. Space Systems Div.

STERILIZATION ASSEMBLY AND DEVELOPMENT LABORATORY: ROUTINE CLEANING AND DECONTAMINATION OF THE SADL FACILITY

E. J. Lunney and E. A. Botan 15 Apr. 1967 16 p Prepared for JPL
(Contracts NAS7-100; JPL-951624)
(NASA-CR-94381; AVSSD-0136-67-CR) CFSTI: HC $3.00/MF $0.65 CSCL 06T

General requirements and procedures are established to ensure that the preliminary microbiological constraints are met for the Sterilization Assembly and Development Laboratory (SADL). The equipment required for each operation is listed, and the preparation of cleaning and germicidal solutions and cleaning equipment is outlined. Tentative SADL cleaning schedules are presented, and the order in which routine cleaning and decontamination is to be carried out is detailed. Quality assurance provisions are defined. M.G.J.

N68-22700# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France).

RADIOBIOLOGICAL STUDY OF THE RADIOPROTECTIVE ACTIVITY OF A NATURAL IRANIAN PRODUCT: "SHIR-KHECHT" [ETUDE RADIOBIOLOGIQUE DE LACTIVITE RADIOPROTECTRICE D UN COMPOSE NATUREL IRANIEN: "SHIR-KHECHT"]

Nasser Rouhanizadeh (Ph.D. Thesis—Paris Univ.) 31 Jan. 1968 86 p refs In FRENCH
(CEA-R-3412) CFSTI: HC $3.00/MF $0.65

After reviewing the primary mechanisms of ionizing radiation, the effects and chemical structures of radioprotective substances, and the methods for studying chemical radioprotection, this paper presents the results obtained with *Shirt-Kecht*, an Iranian manna-base drug. Tests with this product at lethal and sublethal radiation doses were performed on rats using various means of introduction. The effects of radiation were studied using histological and biochemical methods. It was found that this product, which is non-toxic and which can be taken orally, has indeed a protective effect. K.W.

N68-22759*# Avco Corp., Lowell, Mass. Space Systems Div.

STUDY OF THE PLATEAU OF MICROBIOLOGICAL CONTAMINATION ON SURFACES

E. A. Botan 15 Apr. 1967 49 p ref Prepared for JPL
(Contracts NAS7-100; JPL-951624)
(NASA-CR-94342; AVSSD-0149-67-CR) CFSTI: HC $3.00/MF $0.65 CSCL 06T

Vertical laminar air flow is found to accelerate the die-off rate of heterotrophic mesophilic bacteria and vegetative cells with spores which had been exposed on strips of selected materials to both laminar and nonlaminar flow in the Experimental Assembly and Sterilization Laboratory (EASL). Effects of dessication produced by exposure in controlled humidity and temperature ovens as well as in the laminar air flow area of the EASL bioassay room were examined on Escherichia coli, Bacillus globigii and pumilis, and Staphylococcus epidermidis. Die-off of the same species exposed to vertical laminar flow appears to vary with the type of surface material used, and vegetative cells die more rapidly than spores when exposed to vertical laminar flow. M.W.R.

N68-22765*# Avco Corp., Lowell, Mass. Space Systems Div.

EXPERIMENTAL ASSEMBLY AND STERILIZATION LAB. PERSONNEL PROCEDURES FOR EASL OPERATIONS: JPL PROCEDURES EASL 201.01

H. C. Schwartz and E. J. Lunney 15 Apr. 1967 12 p Prepared for JPL Supersedes EASL 201.00
(Contracts NAS7-100; JPL-951624)
(NASA-CR-94351; AVSSD-0135-67-CR; EASL-201.01; EASL-201.00) CFSTI: HC $3.00/MF $0.65 CSCL 06T

Steps for determining and reporting violations to Experimental Assembly and Sterilization Laboratory (EASL) standard contamination prevention procedures are specified. Detailed directions are given pertaining to entrance and work operations in the EASL. These directions conform to the effort to minimize microbiological contamination. E.C.

N68-22848*# Techtran Corp., Glen Burnie, Md.

CONCERNING THE INFLUENCE OF POST-MATURITY OF OVA ON THE SEX RATIO OF FROGS AND BUTTERFLIES [UBER DEN EINFLUSS DER UBERREIFE DER EIER AUF DAS GESCHLECHTSVERHALTNIS VON FROSCHEN UND SCHMETTERLINGEN]

Richard Hertwig Washington NASA May 1968 16 p refs Transl. into ENGLISH from Rept. on Sessions of the Mathematical Phys. Class of the Bavarian Acad. of Sci. (Munich), Jan. 1921 p 269–294
(Contract NASw-1695)
(NASA-TT-F-11683) CFSTI: HC $3.00/MF $0.65 CSCL 06C

The author investigates the causes underlying the sharp sexual redistribution of frogs produced from overripe eggs. The changes result solely from alterations to the ova. The author finds that: overmaturity accelerates the differentiation of the testes; the author's earlier conclusion that changes were produced in the course of egg maturation, was incorrect. In the case of butterflies, overmaturity has no physical effect on the male sex, as it does in frogs. Overmaturity produces rather an increase in the number of females. Author

N68-22850*# Naval School of Aviation Medicine, Pensacola, Fla.

DIAGNOSTIC CRITERIA FOR GRADING THE SEVERITY OF ACUTE MOTION SICKNESS

Ashton Graybiel, Charles D. Wood, Earl F. Miller, II, and Dewey B. Cramer Washington NASA Feb. 1968 14 p refs
(NASA Order R-93)
(NASA-CR-94398; NAMI-1030) CFSTI: HC $3.00/MF $0.65 CSCL 06S

New diagnostic criteria are presented for grading the severity of acute motion sickness. They are more suited to clinical application as empirical evaluations than for precise measurement of physiological functions. The new criteria differ from the old in two important respects: (1) "moderate malaise," previously defined on an exclusion basis, has been divided into two categories and precisely defined, and (2) numerical scoring is optional. By holding fast to the definition of endpoints in the "old" criteria with proven reliability and validity, the change does not seriously affect the findings in experiments where the old criteria were used. Author

N68-22882*# National Aeronautics and Space Administration, Washington, D. C.

AEROSPACE MEDICINE AND BIOLOGY. A CONTINUING BIBLIOGRAPHY WITH INDEXES

Apr. 1968 144 p
(NASA-SP-7011(49)) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Subject coverage concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during the following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Each entry consists of a standard citation accompanied by its abstract. Author

N68-22894# Oak Ridge National Lab., Tenn.

DOSE PREDICTIONS AND BIOLOGICAL CONSEQUENCES FOLLOWING BURNUP OF A Sr^{90} TiO_3 SOURCE IN SPACE

T. G. Clark Aug. 1967 21 p refs Prepared for Sandia Corp.
(SC-CR-67-2792) CFSTI: HC $3.00/MF $0.65

The radiological hazard to the general population from the possible release of ^{90}Sr isotopic fuel in space is studied. Risk estimates are based upon the induction of leukemia and bone cancer in man. Author (NSA)

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N68-21859*# California Univ., San Francisco. Medical Center.

RELATIVE ROLES OF GRAVITATIONAL AND INERTIAL WORK IN THE ENERGY COST OF HUMAN LOCOMOTION

H. J. Ralston and L. Lukin Washington NASA Apr. 1968 18 p refs
(Grant NsG-722)
(NASA-CR-1042) CFSTI: HC$3.00/MF$0.65 CSCL 06S

The metabolic cost of walking was measured during walking on the treadmill at various slopes—positive, level and negative—and before and after loading of the principal body segments. An equation derived from these studies relates metabolic demand to speed of walking under 1/6 g conditions, and is shown to be in acceptable agreement with the data obtained by other investigators for moderate speeds of walking under simulated 1/6 g conditions. The effects of load upon the metabolic cost of walking are shown to be critically dependent upon the segment of the body loaded. Loading of the extremities causes a much greater increase in the metabolic cost of walking than loading of the trunk, due to the greater magnitude of inertial (kinetic energy) work compared with gravitational work. The probable metabolic effects of restraint of free body motion, combined with difficult terrain, are briefly discussed.
Author

N68-21876 Indiana Univ., Bloomington.
THE DETECTION RECOGNITION PROBLEM AND ITS THEORETICAL IMPLICATIONS
William A. Lindner (Ph.D. Thesis) 1966 104 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-3692

This study was concerned with the effect of detection criterion on the ability of human listeners to detect and to recognize sinusoidal signals presented at low intensities in white Gaussian noise. On each trial one of three stimulus events occurred: (1) presentation of a sample of white noise; (2) presentation of a 500 cps signal added to a sample of white noise; or (3) presentation of an 1100 cps signal added to the noise. The probability of noise-alone trial was .30. The two signals each had probability .35. In the detection-recognition condition, each listener made two responses on every trial. He reported whether a signal occurred (detection response) and which of the two alternative signals it was (recognition response). The recognition response was required even when the listener made a negative detection response. The ability of the listeners to detect the signal when they were not required to make the recognition response was measured in the detection condition.
Dissert. Abstr.

N68-21877 Connecticut Univ., Storrs.
CODES AND HUMAN CHANNEL CAPACITY
Jerry Coleman Lamb (Ph.D. Thesis) 1966 84 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-3897

To test the effects of different codes, binary digits, grouped by fours giving 16 different stimulus combinations, were used. The stimuli, either nonredundant or 50% redundant, were printed on standard computer paper with 20 stimuli to each line and 8 lines to a page. Three different types of codes were used. The first was based on the "chunking" effect for short term memory, i.e., a reduction in the number of units and a consequent increase in the information per unit. Each stimulus was coded as one letter of the set of letters from A-P inclusive. The second code type was constructed to be near optimal for information transmission; all responses were composed of different sequences of the letters A and B so that S's response set size was the same as the input alphabet size. The second code was optimal for information transmission but was not chunked. The third code combined the features of the first two codes by using letters of the alphabet from A-E and combining these five letters to produce 16 different responses.
Dissert. Abstr.

N68-21902*# MSA Research Corp., Evans City, Pa.
DEVELOPMENT OF A REGENERABLE CARBON DIOXIDE REMOVAL SYSTEM Final Report, Jun. 1965–Jan. 1968
F. Tepper, F. Vancheri, W. Samuel, and R. Udavcak 15 Jan. 1968 117 p refs
(Contract NAS1-5277)
(NASA-CR-66571) CFSTI: HC$3.00/MF$0.65 CSCL 06K

The investigation of materials other than Molecular Sieve to remove CO_2 in low concentrations for application to future spacecraft life support system needs is reported. A literature survey was conducted and supplemented with small scale tests to screen potential sorber materials. Ion exchange resins, principally weak base types, were selected for further testing. Of the resins tested, IR-45 was selected to develop the necessary system design information. A laboratory system design was selected using a single bed with IR-45 sorber and steam regeneration for one third of a 1-hour cycle. A flight system is projected of about 110 pounds and 470 watts of electrical power or 270 watts electrical power and 300 watts waste heat using the same sorber and system functional design.
Author

N68-21927*# Esso Research and Engineering Co., Linden, N. J. Government Research Div.
INVESTIGATION OF HEATLESS ADSORPTION TECHNOLOGY FOR CARBON DIOXIDE CONTROL FOR MANNED SPACECRAFT
Alvin Skopp and James V. Miceli 1968 103 p refs
(Contract NAS1-6918)
(NASA-CR-66582) CFSTI: HC$3.00/MF$0.65 CSCL 06K

The investigation of heatless adsorption to carbon dioxide control in manned spacecraft is reported. Heatless adsorption is a low power, rapid cycling process that can remove selected components from gaseous streams. The process uses a purge gas at reduced pressure to reactivate the adsorbent. The purge can be either a portion of the product from the adsorbing bed or a portion of the depressurization gas. The heatless adsorption process was evaluated in a two phase program for predrying and for carbon dioxide removal. System design parameters were evaluated using statistically designed experiments. The investigation indicated that air can be dried to a level of 2 to 30 parts per million moisture. Theoretical power requirement for a 3-man system are about 40 to 80 watts depending on the moisture level desired. The use of a purge gas to assist vacuum desorption of carbon dioxide from molecular sieves was not conclusively demonstrated to improve the net efficiency of the process. Though the capacity is improved, the material loss may be increased due to the increase in cycle rate.
Author

N68-22212*# Techtran Corp., Glen Burnie, Md.
PROTECTION OF NAVAL ENGINEER PERSONNEL AGAINST HEAT [PROTECTION CONTRE LA CHALEUR DU PERSONNEL MECHANICIEN DANS LA MARINE NATIONALE]
P. Faltot Broussolle and A. Bernardini Washington NASA Apr. 1968 15 p refs Transl. into ENGLISH from Rev. Corps Sante Armees (Paris), v. 6, 1965 p 37–49
(Contract NASw-1695)
(NASA-TT-F-11613) CFSTI: HC$3.00/MF$0.65 CSCL 06Q

Four types of cool-air ventilation suits were tested in terms of applicability to surface vessels at the zero radiation level and submarines in regular duty in boiler and engine rooms. They were tested for both physiological performance and for practical use. Although inconsistent test parameters preclude final evaluation, specific criticisms are offered on all suits, and advantages and drawbacks are weighed. Precise data are given on the performances and inherent characteristics of the various models: autonomy of movement, comfort to wearer, sound muffling due to back-pack power source, etc.
Author

N68-22316*# Dunlap and Associates, Inc., Darien, Conn.
CONSIDERATIONS FROM ENGINEERING PSYCHOLOGY
R. C. Casperson *In* NASA, Washington Recent Advan. in Display Media 1968 p 133–142 refs (See N68-22302 12-09)

The engineering psychologist is concerned with two classes of requirements in the development and implementation of display media. The first considers the information required by the human operator to perform effectively in a system. The second defines the human factors that are important for the effective transfer of this information via the display to the human operator. Several studies are reviewed and specific visual phenomena are discussed which point out some of the limitations of the available data concerning human visual performance and the faulty conclusions that can derive from the uncritical use of certain "cookbook" data. Some general guidelines are suggested for use by media researchers and display designers to assist them in meeting their ultimate goal: the transfer of useful information to man in a form that is compatible with his sensory-perceptual capabilities. Author

N68-22326*# Beckman Instruments, Inc., Fullerton, Calif.
SAFETY INSTRUMENTATION PACKAGE Final Report
31 Oct. 1966 36 p
(Contract NAS9-3910)
(NASA-CR-92056; FR-2352-101) CFSTI: HC $3.00/MF $0.65 CSCL 06Q

Design approach and new technology required for the Safety Instrumentation Package (SIP), suit equipment to be worn by personnel working inside space simulation chambers, are described. Using mostly modified off-the-shelf equipment, each SIP is instrumented independently of all the others in the chamber. Each SIP unit measures partial pressure of oxygen and carbon dioxide and suit pressure separately; and the only common apparatus involved in these three measurements are the +12 VDC and −6 VDC power supplies. Signal conditioners for pCO_2, pO_2, temperature, and pressure approach the limitations of present state of the art; and account for less than 1/10 of the errors in total system performance. New technology discussed includes the miniature electrochemical pCO_2 sensor and membrane design, the sensor amplifier, and the DC signal conditioners developed for the SIP. M.W.R.

N68-22412*# Avco Corp., Lowell, Mass. Space Systems Div.
EXPERIMENTAL ASSEMBLY AND STERILIZATION LABORATORY: CLOTHING STUDY
E. A. Botan 15 Apr. 1967 68 p Prepared for JPL
(Contracts NAS7-100; JPL-951624)
(NASA-CR-94343; AVSSD-0138-67-CR) CFSTI: HC $3.00/MF $0.65 CSCL 06B

The major objective of this study was to determine the role clothing plays in controlling the dissemination of biological burden (microorganisms) from a worker constructing a printed circuit board assembly. Levels of shedding, approximately 10^3 to 10^5 viable particles per minute, were obtained from individuals wearing street clothes who showered approximately 1 to 2 hours before the test. The shedding was reduced to approximately 10^2 viable particles per minute when these tests were repeated with the same individuals when showered with Phisohex and, in addition, were wearing sterile scrub suits, sterile socks and sterile caps. Shedding therefore could be a major source of biological burden on an assembly. By comparing the buildup of biological burden on an assembly and in the immediate area produced by an individual dressed in a sterile hood, smock, gloves and mask with that produced by the same individual dressed in regular street clothes, a realistic evaluation of clothing requirements could be obtained. Author

N68-22448*# Rensselaer Polytechnic Inst., Troy, N. Y.
FREQUENCY CODED THRESHOLD LOGIC UNIT FOR PATTERN RECOGNITION APPLICATION
Rob Roy and David Hinks Washington NASA May 1968 72 p refs
(Grant NGR-33-018-014)
(NASA-CR-1035) CFSTI: HC $3.00/MF $0.65 CSCL 06B

The principles on which the central nervous system functions are investigated, and their application to pattern recognition problems are discussed. The concepts are then developed in the form of a frequency coded threshold logic element which will employ the advantageous techniques of information transmission exhibited by the sensory nervous system, and improve the performance of the pattern recognition system. The design develops a discriminant function that is a linear combination of weighted frequencies and computed simply as a pulse count; the operating characteristics of the system are delineated. The concept of frequency coding is used to provide a method in which modern digital techniques may be applied to incorporate speed and reliability into the design. The hardware requirements of the proposed design are given in detail and require only moderate expenditure of equipment. B.S.D.

N68-22517*# Avco Corp., Lowell, Mass. Space Systems Div.
STERILIZATION ASSEMBLY DEVELOPMENT LABORATORY. PERSONNEL PROCEDURES FOR SADL OPERATIONS: JPL PROCEDURE SADL 201.00
H. C. Schwartz and E. J. Lunney 15 Apr. 1967 12 p Prepared for JPL
(Contract NAS7-100)
(NASA-CR-94383; AVSSD-0130-67-CR) CFSTI: HC $3.00/MF $0.65 CSCL 06T

This procedure contains standards of personnel cleaning and clothing for entry and during operations in the assembly room or the sterile transfer room of this facility. Lists of minor and major violations are also given. K.W.

N68-22518*# Avco Corp., Lowell, Mass. Space Systems Div.
STERILIZATION ASSEMBLY DEVELOPMENT LABORATORY: QUALITY ASSURANCE PROGRAM PLAN
L. A. Paquin 15 Aug. 1967 86 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951624)
(NASA-CR-94384; AVSSD-0129-67-CR, Rev. 1) CFSTI: HC $3.00/MF $0.65 CSCL 06T

This detailed plan was prepared to maintain a uniformly high level of quality in the Experimental Assembly Sterilization Laboratory (EASL) and the Sterilization Assembly Development Laboratory (SADL) facilities. The plan is applicable for all flight spacecraft that are assembled, inspected, and tested for acceptance in the SADL and EASL facilities. Methods and procedures to assure an effective and economical system maintaining product quality are delineated. Considered in the plan are complexity of design, microbiological burden requirements, interchangeability, manufacturing techniques, decontamination processes, and reliability requirements. K.W.

N68-22519*# Avco Corp., Lowell, Mass. Space Systems Div.
STERILIZATION ASSEMBLY DEVELOPMENT LABORATORY: MONITORING PLAN
J. B. Mathews 15 Aug. 1967 180 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951624)
(NASA-CR-94341; AVSSD-0317-67-CR) CFSTI: HC $3.00/MF $0.65 CSCL 06T

This monitoring plan consists of the test requirements and test procedures to be used to demonstrate: (1) that the Laminar Flow rooms of the Sterilization Assembly Development Laboratory and the Experimental Assembly and Sterilization Laboratory meet the requirements of a Class 100 cleanroom as defined by Federal Standard No. 209a; and (2) that the lab equipment permanently installed in the facility is operating as required for acceptable facility activities. The monitoring plan is limited to the mechanical acceptance criteria. Biological monitoring requirements will be included after the facility has been operated to determine requirements. Author

N68-22521* Avco Corp., Lowell, Mass. Space Systems Div.

ASSEMBLY OF CMTM FOR PURPOSES OF DETERMINING AREAS OF CONTACT DURING THE ASSEMBLY PROCESS, PHASE 2

W. A. Brewer and Paul A. Kales 15 Aug. 1967 45 p ref
Prepared for JPL
(Contracts NAS7-100; JPL-951624)
(NASA-CR-94371; AVSSD-0303-67-CR) CFSTI: $3.00 CSCL 06B

Documentation is presented on the CMTM assembly operations and a determination is made of the locations on the subsystem hardware subject to the greatest handling contamination during assembly procedures. The distributions and allocations of bioassay coupons and ETO sensitive strips throughout the CMTM surfaces are also included. Author

N68-22524*# Avco Corp., Lowell, Mass. Space Systems Div.

CMTM BIOLOGICAL MONITORING PLAN, PHASE 2

Paul A. Kales 10 Oct. 1967 94 p Prepared for JPL
(Contracts NAS7-100; JPL-951624)
(NASA-CR-94370; AVSSD-0323-67-CR, Rev. 1) CFSTI: $3.00 CSCL 06B

Locations are defined for the bioassay coupons to be attached to the surfaces of the capsule mechanical training model (CMTM) subsystem assemblies for removal during assembly operations. Included are coupon removal schedules, the designation of coupons to be assayed, and modifications which can be applied to the schedule for conducting related studies. Author

N68-22573 Joint Publications Research Service, Washington, D. C.

USE OF HIGHER PLANTS TO REGENERATE FOOD, WATER, AND AIR IN CLOSED SYSTEMS

V. P. Dadykin 6 May 1968 15 p refs Transl. into ENGLISH from Sel'skokhozyaystvennaya Biologiya (Moscow), vol. 3, no. 1, 1968 p 137–146
(JPRS-45277)

The use of higher plants in hermetic life support systems to supply food, water, and oxygen in sufficient amounts is considered for human ecology in underwater and space travel systems. Biotechnical criteria of such systems are high productivity, quality of total mass and biochemical composition, and optimal food value with mutual biological compatibility. Several experiments clearly showed a decrease in the rate of CO_2 uptake as plants aged and an increase in the evolution of CO_2 during the dark hours. Lowered partial oxygen pressure in the closed environment activated the processes of CO_2 uptake during daytime hours but caused a substantial increase in the amount of carbon dioxide released during the night. Anoxia provided a protective effect against radiation; tubers exposed to radiation under anoxic conditions remained viable. Experiments with seeds and growing plants under reduced negative pressure of about 7 mm Hg did not affect their later development negatively. G.G.

N68-22756# Israel Program for Scientific Translations, Ltd., Jerusalem.

HYGIENE EFFECTS AND CONTROL OF DUSTS, FOGS, GASES, VAPOURS, RADIOACTIVE PARTICLES

1967 42 p refs Transl. into ENGLISH from German Published for Health, Educ. and Welfare and NSF *Its* Staub-Reinhalt. der Luft, Vol. 27, No. 6, Jun. 1967
(TT-67-51408/6) CFSTI: HC $3.00/MF $0.65

Six papers are presented that deal with health aspects of air polution and controlling dusts, gas, vapor, and radioactive particles in the atmosphere. Emission conditions were investigated in oil-fired furnaces provided with vaporization burners or atomizers, combined and separate determinations were made of nitrogen monoxide and nitrogen dioxide in the atmosphere, and a simple technique is described for measuring hydrocarbon content. The design and operation of a respiratory tract model is described, turbidimetric measurements of finely dispersed technical systems are included, and methods for particle size determination are reported. A patent report describes applications made in March and April 1967; and mention is made of publications from a convention on emission control. M.W.R.

N68-22757*# Avco Corp., Lowell, Mass. Space Systems Div.

EFFECTIVENESS OF UTILIZING ASSAY COUPONS FOR BIOLOGICAL LOAD PREDICTION

E. A. Botan 15 Apr. 1967 50 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951624)
(NASA-CR-94344; AVSSD-0150-67-CR) CFSTI: HC $3.00/MF $0.65 CSCL 06B

Biological assay coupons are considered of value for predicting biological load or burden placed on a printed circuit board. Resistors, capacitors, transistors, relays, modules, and diodes were mounted on each of four boards, which were built in the Experimental Assembly and Sterilization Laboratory (EASL) vertical laminar flow assembly area. Boards 1 and 2 were constructed by an assembler wearing sterile hood, smock, mask, and gloves; boards 3 and 4 by an assembler in street clothing. Boards 2 and 4 had bioassay coupons, boards 1 and 3 did not; and coupon attachment was studied by use of magnets, adhesives, cements, and mechanical devices. The coupons generally distinguish between areas of burden and areas of nonburden, but the coupon technique varies in response when comparing quantitative determinations of burden made by the coupon technique with that of individual piece part assay. Aerobic mesophilic microorganisms were counted in each case. M.W.R.

N68-22779*# TRW Systems, Redondo Beach, Calif.

MEASUREMENTS REPORT: THERMAL PROPERTY MEASUREMENTS OF MANNED SPACECRAFT CENTER SPACESUIT MATERIALS

F. J. Turnbow Apr. 1968 17 p refs
(Contract NAS9-3670)
(NASA-CR-92087; TWR-68-3346.11ja-31) CFSTI: HC $3.00/MF $0.65 CSCL 06K

Thermal radiation properties were measured for teflon coated and uncoated beta cloth, Chromel R, and Lexan coated with LEV 31 and LEV 32 space suit materials. Total hemispherical emittance measurements of the Lexan coated space suit materials were stopped because the test material separated from the heater at higher test temperatures. A difference of several per cent between short and long wavelengh measurements in the spectral overlap region from 2.0 to 2.5 microns was confirmed for Chromel R; and the beta cloth showed a difference in measured reflectance in this region between the paraboloid and integrating sphere. Since the integrating sphere beta cloth was taped flat on the holder and the paraboloid sample was held by a nut and puffed slightly when tightened, it was concluded that there was more absorption in the latter because the rays scatter more. M.W.R.

N68-22807# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

A STUDY OF THE MECHANICS OF HUMAN BALANCING FOR POTENTIAL APPLICATION TO THE CONTROL OF VEHICLES. PART 2: TOWARD A MATHEMATICAL MODEL OF VERTICAL BALANCING IN EARTH GRAVITY

E. Seckel (Aeron. Res. Associates of Princeton), H. Breul, T. Keller, S. Suh, and R. Weston Jul. 1967 45 p refs
(RM-369) CFSTI: HC $3.00/MF $0.65

A mathematical model, in differential equation form, of the closed-loop control behavior of a standing human, balancing a simulated, jet supported, hovering platform, has been derived. The form of the model was postulated from theoretical stability considerations. Numerical values of its coefficients were identified by a manual matching technique in which potentiometers, representing human response parameters in an analog computer model of the complete system, were manipulated so as to minimize the rms difference between real and model control (ankle deflection) responses to random disturbances. The model represents the pilot's ankle deflection as a delayed function of vehicle displacement, vehicle velocity, pilot's body tilt, and pilot's body tilt rate. Its output compares very well with the real pilot output in both the frequency and time domains. Author

N68-22815*# National Aeronautics and Space Administration, Washington, D. C.

INFORMATION PROCESSING IN THE FUNCTIONAL VISUAL FIELD [INFORMATIEVERWORKING IN HET FUNKTIONEEL GEZICHTSVELD]

A. F. Sanders Dec. 1967 13 p refs Transl. into ENGLISH from Dutch, Rept. no. IZF 1967–68
(NASA-TT-F-11408) CFSTI: HC$3.00/MF$0.65 CSCL 06D

It has been found that performance in a number of visual tasks does not linearily decline as a function of visual angle. Instead, there are stepwise drops at two visual angles, which proved to be the boundaries of the areas where inspection by means of peripheral vision and eye movements were sufficient to obtain optimal performance. The drops were explained in terms of strategies in processing visual information, which were thought to vary from grouping signals at small visual angles to successive handling at very large angles. This theory is reevaluated in the light of more recent notions on visual coding and recoding. Especially the relation between grouping and perceptual organization is considered. It is concluded that the earlier work is restricted to the macrostructure of the functional visual field. Author

N68-22824# General Electric Co., Philadelphia, Pa.

SIMULATION TECHNOLOGY—A HUMAN ENGINEERING BIBLIOGRAPHY

R. B. Webster 7 Apr. 1967 52 p refs
(Doc.-67SD265)

A list of 493 citations in the form of unclassified articles, presentations, reports, reviews, surveys and texts was developed as a general introductory reference to the literature of simulation technology as applicable to human engineering. This article is divided into two parts—classification and bibliography. The classification section contains the 13 headings under which the citations are categorized. The series of numbers following each heading refer to the similar-numbered citations in the bibliography thus enabling a systematic utilization of the material. The bibliography section contains the citations listed alphabetically by author with each entry numbered consecutively. Author

N68-22876# Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule.

TRITIUM. MEANS OF DETECTION AND OF PROTECTION [LE TRITIUM. MOYENS DE DETECTION ET DE PROTECTION]

Yves Sutra-Fourcade Dec. 1967 104 p refs In FRENCH; ENGLISH summary
(CEA-R-3350) CFSTI: HC$3.00/MF$0.65

The report is an attempt to correlate present data concerning tritium, especially from the health physics points of view. Methods are reviewed for measurement of tritium in the atmosphere, in liquids, and on surfaces. The operation of various types of apparatus is analyzed, and the sensitivity limits deduced from laboratory tests are given. Also discussed are the means of protection against inhalation of tritium (ventilation, protective clothing), decontamination of equipment, and calculations of atmospheric pollution and exposure. Author

N68-22993# Israel Program for Scientific Translations, Ltd., Jerusalem.

HYGIENE EFFECTS AND CONTROL OF DUSTS, FOGS, GASES, VAPOURS, RADIOACTIVE PARTICLES

1967 42 p refs Transl. into ENGLISH from German Published for Health, Educ. and Welfare and NSF *Its* Staub–Reinhalt. der Luft, vol. 27, no. 4, Apr. 1967
(TT-67-51408/4) CFSTI: HC$3.00/MF$0.65

Discussed are the following topics: (1) *The Use of Propagation Formulas to Calculate Minimum Chimney Heights with Respect to Their Environment*—probability consideration for a simplified method of adding dimensioning sections to a chimney in case of buildings or trees reaching the chimney height; (2) *The Operation of Electroprecipitators with Pulse Voltages*—increased dust separation efficiency by direct voltage components and impulse parameters; (3) *Measurements of Soot Concentration in the Combustion Gases of Some Liquid Fuels*—improved measurements with electrostatic soot precipitator and optical soot density meter; (4) *Determining the Tolerance Range of the Mean Value of Dust Concentration*—equation for tolerance range of average value for dust concentration; (5) *Use of the Goetz Aerosol Spectrometer to Measure the Size Spectra of Polydispersed Aerosols*—calibration of aerosol spectrometer; (6) *The Theory of the Coincidence Error for Digital Particle Size Analysis*—extended coincidence theory for Coulter counter; (7) *An Improved Method Using the Bahco Separator*—microscopic dust particle separation; and (8) *Investigation on the Danger of Soot, Particularly Its Carcinogenic Effect*—implantation tests of soot and airborne dusts in rats. Also included is a patent report that covers patent applications and registered designs for aerosol control. G.G.

N68-23025# Israel Program for Scientific Translations, Ltd., Jerusalem.

HYGIENE EFFECTS AND CONTROL OF DUSTS, FOGS, GASES, VAPOURS, RADIOACTIVE PARTICLES

1967 48 p refs Transl. into ENGLISH from German Published for Health, Educ. and Welfare and NSF *Its* Staub-Reinhalt. der Luft, Vol. 27, No. 5, May 1967
(TT-67-51408/5) CFSTI: HC$2.00/MF$0.65

Significance of fine mineral particles in nature and technology is discussed, didactic importance of the exhibition of pulverulent materials is considered, and dust measuring technology and the classification of tests are treated from the point of view of the dust control expert. Other articles deal with changes in the meaning of amorphous and colloid following structural analysis by electron microscopy; the morphology of finely particulate oxides and hydroxides of iron, aluminum, and manganese; the morphology of pulverulent polymers; electron microscopic study of temperature-sensitive colloids; and influence of pulverulent components in plant protection. Experiences are reported for an instrument to determine electrical dust resistance; and briefs are included for industrial experience with a clean air filter, CO-determination in exhaled air, a paper sack ripping machine, and a low pressure radial fan. Two patent applications in February and March 1967 are summarized. M.W.R.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N68-21860 Rensselaer Polytechnic Inst., Troy, N. Y.

ADSORPTION OF SIMPLE GASES ON EVAPORATED BORON FILMS

Peter Edward McElligott (Ph.D. Thesis) 1966 157 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-4184

The adsorption behavior of H_2, N_2, O_2, and CO has been studied on evaporated films of amorphous boron at 300°K. A method of preparing atomically clean evaporated boron films under ultrahigh vacuum conditions is discussed in detail. The films are at least 99.5 atomic percent boron and have B.E.T. surfaces areas in the range 1000–1200 cm^2. Evidence is presented for believing that H_2, O_2, and CO chemisorb readily on these films at 300°K. Nitrogen is not observed to chemisorb to any significant extent on the boron films at 300°K. The adsorption behavior of these gases on boron is compared with that reported for silicon and germanium surfaces. In particular it is found that chemisorption of H_2 and CO is easier on boron than on other semiconductor surfaces. Dissert. Abstr.

N68-21861# Joint Publications Research Service, Washington, D. C.
STUDIES IN EAST EUROPEAN SCIENTIFIC DEVELOPMENT
11 Apr. 1967 27 p refs
(JPRS-45021) CFSTI: HC$3.00/MF$0.65

CONTENTS:

1. MORE FOREIGN SCIENTIFIC CONTACTS CALLED FOR Valer Novacu p 1–6
2. VALUE OF UNIVERSITY RESEARCH STRESSED Nicolae Teodorescu p 7–11
3. NEW APPLICATIONS OF LEAD-TETRAACETATE IN ORGANIC CHEMISTRY M. Lj. Mihailovic p 12–20 refs (See N68-21862 12-06)
4. QUANTIFICATION OF THE PROBLEM OF BUILDING MODELS OF REACTION MECHANISMS A. Despic p 21–26 (See N68-21863 12-06)

N68-21862# Joint Publications Research Service, Washington, D. C.
NEW APPLICATIONS OF LEAD-TETRAACETATE IN ORGANIC CHEMISTRY
Mihailo Lj. Mihailovic *In its* Studies in East European Sci. Develop. 11 Apr. 1967 p 12–20 refs Transl. into ENGLISH from the publ. "Spomenica u Cast Novoizabranih Clanova Srpske Akademije Nauka i Umetnosti" Serbo-Croatian, 1967 p 156–164 (See N68-21861 12-06)

Applications of lead tetraacetate as an oxidizing agent in synthetic and degradation processes in organic chemistry are described. One such application is the oxidation of alcohol with lead tetraacetate, $Ro(OAc)_4$, in a nonpolar solvent, so that the oxygen of the alcohol, through intramolecular substitution with hydrogen, is bonded to the inactivated center, usually the delta-carbon atom, yielding the corresponding cyclic ether. There are two other important processes in the reaction between monohydroxyl alcohols and lead tetraacetate: fragmentation and oxidation into the corresponding carbonyl compounds. The fragmentation reaction is used in the synthesis of physiologically active 19-norsteroids and steroid derivatives. The oxidation of alcohols with lead tetraacetate is used as a preparative method to obtain aldehydes and ketones when the reaction takes place in the presence of an excess of pyridine at ordinary or somewhat elevated temperatures. R.N.A.

N68-21863# Joint Publications Research Service, Washington, D. C.
QUANTIFICATION OF THE PROBLEM OF BUILDING MODELS OF REACTION MECHANISMS
Aleksandar Despic *In its* Studies in East European Sci. Develop. 11 Apr. 1967 p 21–26 refs Transl. into ENGLISH from the publ. "Spomenica u Cast Novoizabranih Clanova Srpske Akademije Nauka i Umetnosti" Serbo-Croatian, 1967 p 80–86 (See N68-21861 12-06)

The problem of constructing models of the mechanisms involved in a chemical reaction is considered, in which the basic stages of the reaction depend directly and exclusively on the number and type of stable molecules and unstable intermediates in the system. A formal mathematical method of building all possible stages was developed on a digital computer, using the electrochemical oxidation of ammonia as a sample reaction. It turned out that with four stable molecules and ten probable intermediary stages, it was necessary to investigate 28,084 systems of linear equations and that there are 49 chemical and 26 electrochemical stages which could participate in the reaction mechanism. An equation was set up to limit the number of determinants to be solved. However, it was found that the number of systems of equations which must be investigated, even for a simple reaction such as the oxidation of ammonia, is on the order of magnitude 2×10^{13}. This raises the question of whether it is worthwhile to know that an enormous number of models satisfies a restricted set of kinetic data. R.N.A.

N68-21883 British Columbia Univ., Vancouver.
THE OXIDATION OF 2-BUTENES
Ronald Siu-man Tse (Ph.D. Thesis) 1966 172 p
Available from Natl. Library of Can. at Ottawa: MF$1.50

In the first part of this work, the reaction between cis- and trans-2-butenes and oxygen atoms was studied at room temperature in a flow reactor in the essential absence of molecular oxygen. Products were analysed by gas chromatography. These reaction products were found to consist of hydrocarbons and oxygenated products in the ratio of approximately 2:1. In the second part of this work, the thermal oxidation of cis- and trans-2-butenes by molecular oxygen was investigated in a conventional static system. Pressure-time studies were made at 289°C and at a total initial pressure of 51 mm Hg. Cool flames were observed at the end of an induction period when the ratio $(p_{O_2}/p_{2\text{-butene}})$ was greater than unity but not very large. When this ratio became very large, no cool flame was observed but the pressure-time curve took on a simple S-shape. When this ratio became less than unity, no pressure increase was detected at the end of the induction period. Dissert. Abstr.

N68-21933*# Polytechnic Inst. of Brooklyn, N. Y.
STUDY OF PHOTOSENSITIZED DECOMPOSITION OF HYDROPEROXIDES Final Report
Gerald Oster 31 Jul. 1967 127 p refs
(Grant NGR-33-006-017)
(NASA-CR-94252) CFSTI: HC$3.00/MF$0.65 CSCL 07C

Research was conducted to provide a source of molecular oxygen which could be regulated by light. The research was prompted by the discovery that chlorophyll in solution will sensitize (for red light) the photodecomposition of organic hydroperoxides. This is accompanied by the evolution of oxygen. The effect has been studied for organic peroxides where transient species of chlorophyll are observed. The kinetics of peroxide decomposition is reviewed. Chlorophyll-sensitized decomposition of hydroperoxides is postulated to take place in the living plant. It was found that hydroperoxides are formed on irradiation of chloroplasts with red light. Manganese (as Mn^{++}) has been implicated in the oxygen evolution mechanism of photosynthesis. Manganese chelates were used as substrates for photosensitized reactions. Tetrazolium salts undergo photoreduction to produce the corresponding formazans. Suspensions of zinc oxide flushed with carbon dioxide produce on irradiation oxygen and formaldehyde. A review has been prepared on the various ways free radicals produced by light will initiate polymerization of vinyl monomers. Author

N68-21951# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
ON THE BIOLOGICAL INTERPRETATION OF DOSE FROM ACCELERATOR-PRODUCED RADIATION

Roger Wallace, ed. 16 Mar. 1967 389 p refs Proc. of the 1st Intern. Symp. held at Berkeley, Calif., 13–16 Mar. 1967 (CONF-670305) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. FUNDAMENTAL RADIOBIOLOGY FOR THE HIGH-ENERGY ACCELERATOR HEALTH PHYSICIST V. P. Bond, J. S. Robertson, T. Brustad, S. Wolff, G. W. Barendsen et al p 1–14 refs (See N68-21952 12-04)

2. SOMATIC AND GENETIC EFFECTS IN ANIMALS AND HUMANS W. L. Russell, H. Parker, C. Lushbaugh, J. F. Fowler, L. A. Sagan et al (Oak Ridge Natl. Lab.) p 81–87 refs (See N68-21953 12-04)

3. THE CONTRIBUTION OF BIOLOGY TO STANDARDS OF RADIATION PROTECTION S. M. Nabrit p 192–196 (See N68-21954 12-04)

4. PHYSICAL FACTORS IN RADIATION PROTECTION C. A. Sondhaus, H. Maccabee, S. B. Curtis, R. D. Birkhoff, G. R. Holeman et al (Calif. Coll. of Med.) p 197–220 refs (See N68-21955 12-04)

5. NEW DEVELOPMENT AND RECENT EXPERIENCE N. A. Baily, C. A. Tobias, C. Richman, J. M. Feola, and A. Norman (Calif. Univ.) p 329–345 refs (See N68-21956 12-04)

N68-21976 Stanford Univ., Calif.

FAR INFRARED SPECTROSCOPY OF IONS IN CRYSTALS

Edwin Donald Nelson (Ph.D. Thesis) 1966 129 p

Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-4413

Two problems involving far infrared spectroscopy of ions in crystals have been solved. The first result has served to clear up some uncertainty about the pair lines observed in concentrated ruby. Far i.r. lines had previously been attributed to pairs of Cr^{3+} ions. They have now been shown to be due to some other impurity, and not to chromium ion pairs. This result is much more compatible with the observed optical spectrum of concentrated ruby and with theoretical estimates of the transition probabilities between the low lying levels of Cr^{3+} pairs. The second problem solved was the determination of the positions of the low lying levels of the Ti^{3+} ion in corundum and the measurement and explanation of the linewidths of the transitions between these levels as a function of temperature. Dissert. Abstr.

N68-21984 Ohio State Univ., Columbus.

SOLUBILITY, SEGREGATION, AND DIFFUSION OF SULFUR IN α – IRON

William Henry Herrnstein, III (Ph.D. Thesis) 1966 198 p

Available from Univ. Microfilms: HC $9.00/MF $3.00 Order No. 67-6322

It was the purpose of this study to provide reliable data on the effect of iron purity and structural perfection on the solubility, degree of equilibrium segregation, and diffusion of sulfur in α iron. Three grades of ferrite, having total impurity contents ranging from 50 to 500 ppm, were considered in the study. Two methods, an encapsulation method and a recirculating-flowing-gas method, were employed to sulfurize polycrystalline and single crystal specimens by equilibration with H_2–H_2S atmospheres. Single crystal specimens were produced by the strain-gradient anneal technique. Sulfur analysis was performed by the combustion-iodiometric titration method. Indirect evidence is presented for the equilibrium segregation of sulfur at ferrite grain boundaries in the 750° to 910°C temperature range to a degree which is in accord with theoretical considerations, i.e., up to a monolayer of adsorbate at the boundaries. Dissert. Abstr.

N68-21991 Virginia Univ., Charlottesville.

DYNAMICS OF GAS ABSORPTION IN A WETTED-WALL COLUMN

Lakshmi Prakash Sharma (Ph.D. Thesis) 1966 438 p

Available from Univ. Microfilms: HC $19.80/MF $5.60 Order No. 67-3778

The dynamics of the absorption of ammonia from air into water in a wetted-wall column have been studied. The gas rose past the water film flowing down a 35-in. column (1-in. I.D.). A concentration pulse of ammonia was injected into a steady air flow. As a result of absorption in the water, the concentration of ammonia in the effluent stream exhibited a pulse-like change also. The performance function determined was the ratio, in the Laplace domain, of outlet liquid to inlet gas concentrations. The output and input pulses as time series were Fourier-transformed with Filon's quadrature formula, using the B5000/5500 computer. From these transforms, magnitude ratios and phase differences were computed; and mathematical techniques were developed for evaluation of mixing time constants and transport lags from these data. These parameters were evaluated on the computer by a weighted least-square fitting technique without recourse to the trial and error methods. Dissert. Abstr.

N68-22005 Pittsburgh Univ., Pa.

A SINGLE CRYSTAL STUDY OF SOME TRANSITION METAL COMPLEXES

Garry George Messmer (Ph.D. Thesis) 1966 130 p

Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-4571

In order to gain a better understanding of the bonding in the "trans" effect, the crystal structures of some transition metal complexes were determined. Complete three-dimensional single crystal structure analyses were performed on chloropentammine-cobalt(III) chloride, *trans*-dibromobis(triethylphosphine) platinum(II), *cis*-dichlorobis(trimethylphosphine) platinum(II) and two-dimensional analysis on *trans*-dichlorobis(triethylphosphine) platinum(II) with diffractometer data. These structures were refined by complete matrix least-squares including anistropic temperature factors and real and imaginary anomalous dispersion corrections. Dissert. Abstr.

N68-22014*# TRW Systems, Redondo Beach, Calif.

CHEMICAL SPECIES AND CHEMICAL REACTIONS OF IMPORTANCE IN NONEQUILIBRIUM PERFORMANCE CALCULATIONS

P. I. Gold and C. T. Weekley 6 Dec. 1966 76 p refs (Contract NAS9-4358)

(NASA-CR-92057; TRW-02874-6001-R000) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Four computer programs were developed in Fortran 4 to calculate inviscid one-dimensional and axisymmetric nonequilibrium nozzle flow fields that account for the nonequilibrium effects of finite chemical reactions between gaseous combustion products and velocity and thermal lags between gaseous and condensed combustion products. Each of the four programs is completely self-contained and requires only the specification of the elemental composition and heat of formation of the propellant system, relaxation rates, and nozzle geometry. Chemical species considered by the programs permit accurate equilibrium, frozen and kinetic performance analyses of all types of propellants. Both chemical and gas-particle relaxation losses can be considered simultaneously in propellant systems with condensed exhaust products. Chemical species, chemical reaction, and chemical reaction rate studies are reported. M.W.R.

N68-22021*# Techtran Corp., Glen Burnie, Md.

PEROXIDES OF THE ALKALINE EARTHS [UBER DIE PEROXYDE DER ERDALKALIEN]

E. H. Riesenfeld and W. Nottebohm Washington NASA Apr. 1968 10 p refs Transl. into ENGLISH from Z. Anorg. Allgem. Chem. (Leipzig), v. 89, 1914 p 405–413
(Contract NASw-1695)
(NASA-TT-F-11641) CFSTI: HC$3.00/MF$0.65 CSCL 07B

Alkaline earth peroxides are prepared by oxidation of the hydroxide with hydrogen peroxide. Depending on the conditions, pure peroxides, their hydrates or peroxyhydrates were produced. This paper is a study of the stability of these compounds. Author

N68-22031 Pittsburgh Univ., Pa.

A CRYSTALLOGRAPHIC STRUCTURE STUDY OF SOME METAL X BONDS, X = C, S, N

Robert G. Vranka (Ph.D. Thesis) 1966 107 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-3046

The formation of coordination compounds involving Ag(I) and Cu(I) ions, which are electronically similar, have been investigated. In the case of Ag(I), the complexing ability of pyrazine and some of its derivatives were experimentally determined. Single crystals of $AgNO_3$-pyrazine were grown in an aqueous solution containing $AgNO_3$ and pyrazine. From an x-ray diffraction investigation, the crystals were found to be monoclinic. The structure analysis shows that coordination by pyrazine occurs through the lone pair electrons on the nitrogen atoms with no change in the distances of the aromatic ring. A complex involving Cu(I) which was synthesized contained thiourea as the coordinating ligand. A detailed structural analysis was carried out to determine why Cu(I) can combine with thiourea to form such varied and diverse stoichiometries. A structure refinement of dimeric trimethyl aluminum was carried out to determine whether the hydrogen atoms of the methyl groups were involved in the bridging bonds. Dissert. Abstr.

N68-22051 British Columbia Univ., Vancouver.

THE PHOTOIONIZATION AND DISSOCIATION OF MOLECULES

Shiu Hung Mak Danny (Ph.D. Thesis) 1966 108 p
Available from Natl. Library of Can. at Ottawa: MF $1.50

Photoionization efficiency curves of sixteen atoms and molecules, namely: argon, krypton, xenon, oxygen, nitrogen, carbon monoxide, chlorine, hydrogen chloride, ammonia, water, methane, methane-d_4, propylene, acetylene, methyl cyanide and methyl alcohol for the energy range from eight to twenty-one electron volts were obtained. Numerical values of ionization and appearance potentials were determined from the initial onset of the photoionization efficiency curves, and the ionization potentials are discussed and compared with those obtained by other investigators. The threshold ionization potentials of these molecules are in close agreement with the spectroscopic values and are superior to those obtained by the electron impact method. Dissert. Abstr.

N68-22062 Temple Univ., Philadelphia, Pa.

STUDIES ON THE PERMEATION OF ISOLATED ZIRCONIUM OXIDE FILMS BY ELECTROLYTES IN SOLUTION

Albert Haywood Mitchell (Ph.D. Thesis) 1966 141 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-3219

The transfer of electrolyte solutions was investigated across isolated anodic zirconium oxide films, which are thin barrier-type layers which contain few flaws. A measure of their degree of perfection, the anodic leakage current was found to increase with film thickness increase. The permeation of these films by potassium nitrate showed that reproducible data could be obtained. The rate of permeation was found to be proportional to the isolated film area and the concentration of the permeating electrolyte and inversely proportional to the film thickness. An Arrhenius-type temperature dependence, which allowed the determination of an activation energy for the process, changed with the film thickness. The results were found to fit a model for permeation which proposed ion transport through charged pores where the potential hindered transport of ions of the appropriate sign. The model criterion that the activation energy for the permeation should be proportional to the logarithm of the membrane thickness was met by the experimental results. Dissert. Abstr.

N68-22071 Mississippi State Univ., State College.

ADSORPTION OF METHANE GAS ON CARBON BLACK AND SILICA AT HIGH PRESSURES

Thomas Donnie Stacy (Ph.D. Thesis) 1966 159 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-3993

This investigation obtained fundamental adsorption data for methane gas on Spheron-6 and Linde silica for pressures up to 10,000 psia and temperature range of 100° to 250°F. The apparatus made use of a high pressure volumetric cell in which gas was compressed in the presence of the adsorbent. Total gas in the system was measured by withdrawing gas in a stepwise manner into a calibrated low pressure system. The amount adsorbed was taken as the difference in the measured quantity and that quantity indicated in the adsorption cell. The latter quantity was calculated by application of the gas law with corrections for non-ideality. Dead space volume determination was made by expansion of helium into the adsorption cell with the assumption that helium was not adsorbed. Desorption isotherms were taken at 30° increments. Isotherms similar to the Langmuir type were obtained. A modification of the characteristic function of Polanyi was successfully used in correlating the data. The correlation includes an approximation of the molal volume of the adsorbed phase. Dissert. Abstr.

N68-22081 Tulane Univ., New Orleans, La.

A NEW APPROACH TO NONLINEAR CHEMICAL REACTION RATE EQUATIONS INVOLVING APPROXIMATIONS TO THE SOLUTION OF A SYSTEM OF FIRST AND SECOND ORDER CHEMICAL REACTION RATE EQUATIONS

James Richard Chalfant (Ph.D. Thesis) 1966 159 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-3836

A matrix formulation has been developed for the kinetic equations of any system of first and second order reactions with constant parameters of temperature, pressure, etc. The resultant matrix equations could be used in any of several finite difference techniques written for scalar equations, or conclusions could be drawn concerning system behavior from examination of the matrices without recourse to actual solution of the equations. The matrix formulation also suggested a possible analytic approximation to the solution of the arbitrarily large system. Parameters in the approximation were determined by matching known initial values, initial derivatives, and asymptotic behavior. A state space representation was devised for the presentation of three-reaction subsystems in which the approximations were compared to numerical solutions for several systems of up to ten reactions. Dissert. Abstr.

N68-22176 Nebraska Univ., Lincoln.

STUDIES ON POLYMERIC CHELATES

Harold Dwain Coble (Ph.D. Thesis) 1966 77 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-4056

One of the types of polymers which potentially could show good thermal stability is a chelate polymer. A bifunctional ligand, when allowed to react with a suitable metal ion, should form long chain polymeric chelates. In order to facilitate a comparison of properties, the copper chelates of these ligands were prepared under the same general conditions. The reactions were carried out in dimethylformamide solvent with both metal salt and ligand at a fixed concentration. In addition, the nickel chelates of 1,4- and 1,5-dihydroxyanthraquinone and the nickel, zinc, and cadmium derivatives of 5,11-dihydroxynaphthacenequinone were prepared by this same general method. The chelates were shown to be polymeric by elemental analyses and infrared spectral data. The relative thermal stabilities of the polymers were determined by the method of differential thermal analysis. Dissert. Abstr.

N68-22177 Northwestern Univ., Evanston, Ill.

HYDROGEN, ISOMERIZATION AND EXCHANGE REACTIONS ON PARTIALLY ACTIVATED CHROMIUM OXIDE CATALYSTS

Gary Lee Haller (Ph.D. Thesis) 1966 125 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-4229

Hydrogenation and double bond isomerization of 1-hexene at 64°C and isotopic exchange between deuterium and toluene at 110°C were studied on chromium oxide gel catalysts which had been activated in hydrogen at temperatures between 200–400°C. The reaction products of 1-hexene deuterogenation and isomerization were separated chromatographically and the isotopic distributions determined mass spectrometrically. The isotopic distributions in the ring and in the methyl group of toluene were determined by a combination of NMR and mass spectrometric analyses. The relative rates of exchange of the ortho, meta and para ring positions of toluene were determined from infrared spectra. Dissert. Abstr.

N68-22178# Florida Univ., Gainesville.

FORMATION OF NEGATIVE IONS BY SURFACE IONIZATION

Charles Stephen Harden (Ph.D. Thesis) 1966 45 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-3477

An apparatus for studying the formation of ions on an incandescent metal surface has been constructed. The ions thus formed are mass analyzed using a 3-inch radius of curvature, 90° sector, magnetic deflection mass spectrometer. By studying the ratios of the ion currents of two atomic species emitted from the surface as a function of the surface temperature, it is possible to determine the difference in the electron affinities of the two atoms. In the case of surface ionization of molecular electronegative species it is also possible, with accurate data, to determine vibrational and rotational constants for the negative ion. Molecular beams of chlorine, Freons (CF_mCl_n), chloroacetonitrile, and chloropicrin are allowed to strike a heated polycrystalline tungsten surface in order to explore the feasibility of using polyatomic molecules for the determination of electron affinity differences and to examine the dissociation of the molecules as a function of the surface temperature. Dissert. Abstr.

N68-22180 Connecticut Univ., Storrs.

THE EFFECT OF TEMPERATURE ON INFRARED SPECTRA

James Martin Kelliher, Jr. (Ph.D. Thesis) 1966 62 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-3888

The effects of temperature variation on fundamental absorption bands were studied for a series of halogen substituted methanes in carbon disulfide solutions. The halogenated methanes include methyl bromide and iodide; methylene chloride, bromide and iodide; chloroform, bromoform and carbon tetrachlorides. The CH bending modes and the CCl stretching modes in these compounds were investigated. The integrated intensities of these vibrational absorption bands show no general effects of temperature. Trends are observed for the same mode of vibration for a series of compounds of the same symmetry class. The changes in band shape accompanying the variation of temperature have been noted. As the temperature was lowered all bands showed an increase at maximum absorbance. Nearly all bands became narrower and the half band widths approach the limit of the resolving power of the spectrometer used. These effects have been correlated with the decrease in librational motion of molecules. Dissert. Abstr.

N68-22181 Western Reserve Univ., Cleveland, Ohio.

KINETICS OF THE OXYGEN PEROXIDE COUPLE ON GRAPHITE

Ikram Hilimy Morcos (Ph.D. Thesis) 1966 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-4650

The present work has involved the further study of the oxygen–peroxide couple on graphite with particular emphasis on establishing the reaction orders and examining the dependence of the kinetics on the orientation of the electrode surface relative to the prevailing layer structure. The relatively well defined surface properties of the now available pyrolytic and natural single crystal graphites have provided a considerable incentive for the present research. High pressure annealed and naturally single crystal graphites as well as ordinary pyrolytic graphite were used in this investigation. Both the cleavage and the edge surfaces of the high pressure annealed graphite and the cleavage surface of the single crystal graphite were examined. The experimental results showed that the reduction of O_2 to HO_2^- and the reverse anodic process proceed readily on all graphite surfaces except the cleavage surfaces of both the high pressure annealed pyrolytic and single crystal graphites. Dissert. Abstr.

N68-22208 Pittsburgh Univ., Pa.

EFFECT OF TEMPERATURE ON THE SYNTHESIS OF CERIUM CHALCOGENIDES

Samuel H. Klinvex (Ph.D. Thesis) 1966 91 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-4144

The purpose of this investigation was to develop an isothermal study for the cerium–sulfur compositions synthesized over the temperature range of 600°C to 1300°C in 25 degree increments. Cerium sulfide compounds were synthesized under a carbon disulfide atmosphere from ceria (CeO_2) in a carbon combustion tube furnace. The crystal structures were studied by X-ray diffraction techniques using filtered chromium K alpha radiation. Cerium dissolves 25 per cent sulfur at 1300°C and 27 per cent at 1115°C, forming a Th_3P_4 type body-centered cubic structure. Complex X-ray diffraction spectra were obtained for the cerium sulfide compounds prepared below 1100°C. From 950°C to 1100°C, two cubic phases have been indexed as follows: a body-centered cubic Ce_3S_4 type structure with an a_0 value of 8.65 A being the predominant phase, the second phase is simple cubic with an a_0 value of 8.85 A. Dissert. Abstr.

N68-22224*# National Bureau of Standards, Boulder, Colo.

ELECTROCHEMICAL DATA. PART 9: ELECTROLYTIC CONDUCTIVITY OF AQUEOUS SOLUTIONS OF HYDROFLUORIC ACID

Harold J. De Wane and Walter J. Hamer 11 Apr. 1968 17 p refs
(Contract R-09-022-029)
(NASA-CR-94359; NBS-9812, Pt. 9) CSCL 07D

A critical evaluation is given of available data on the electrolytic conductivity of aqueous solutions of hydrofluoric acid at 0°, 16°, 18°, 20° and 25°C. The data at 25°C are more extensive than at the other temperatures. Data on the densities of aqueous solutions of hydrofluoric acid covering these five temperatures are also included. Author

N68-22236*# American Oil Co., Whiting, Ind. Research and Development Dept.

TEST AND EVALUATION OF FUEL CELL CATALYSTS

Final Report, 3 May 1967–3 May 1968

R. J. Flannery and R. F. Waters 3 May 1968 20 p
(Contract NASw-1597)
(NASA-CR-94360; Q-4) CSCL 07D

Seven new interstitial compounds were received and tested both for corrosion resistance and anode activity in carbonate–bicarbonate electrolyte. The new compounds are listed, and the preparation method and composition are indicated. In the corrosion tests two of the compounds that contained chromium were eliminated from further testing due to obvious dissolution of this metal. The remaining five electrodes were tested for anodic activity. Significant corrosion currents were observed in each case. there was anodic activity with hydrogen that was well in excess of the anodic corrosion activity, and the propane activity of each was very low. In the present tests the carbides were slighly more active than the nitrocarbides in previous tests. Author

N68-22243 Northwestern Univ., Evanston, Ill.

PRECIPITATION FROM MAGNESIOFERRITES SOLID SOLUTION

Gerald Paul Wirtz (Ph.D. Thesis) 1966 178 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-4281

The precipitation of octahedrally shaped magnesioferrite particles from MgO samples containing approximately 1 cation % iron was followed by transmission electron microscopy and magnetic measurements. The precipitate particles developed on aging at 700 and 800°C were shown to be superparamagnetic above 10°K. Initial susceptibilities measured at 77°K varied from 5.8×10^{-4} emu/cm ^{3}Oer. for a sample aged for 6 min. at 700°C, to 8.3×10^{-2} emu/cm ^{3}Oer. for a specimen aged for 145 hrs. at 800°C. Growth of precipitate particles was shown to occur by diffusion controlled coarsening after 1 hour at 800°C. The final volume fraction of precipitate was shown to depend on the concentration of Fe^{+++} ions in the initial solution. Raising the solution treating temperature (from 1440°C to 1575°C) decreased the equilibrium concentration of Fe^{+++} ions and resulted in a decrease of >20% in the final volume fraction of precipitate. On the other hand, the composition and cation distribution of the precipitate was unaffected by the solution treating temperature and determined solely by the aging temperature. Dissert. Abstr.

N68-22358 Pennsylvania Univ., Philadelphia.

NUCLEAR MAGNETIC RESONANCE IN FERRIMAGNETIC MATERIALS

Theodore Warren Houston (Ph.D. Thesis) 1966 148 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-3077

This thesis reports the temperature and external field dependence of the ^{55}Mn nuclear magnetic resonance in $Mn_xFe_{3-x}O_4(.1 \leq x \leq 1)$, $MnCr_2O_4$, and Mn_3O_4 in an investigation of the basic ferrimagnetic interactions as well as the magnetic properties of these materials. All three materials have the spinel crystal structure although Mn_3O_4 is tetragonally distorted ($c/a = 1.14$). Nevertheless, because of varying ratios of the three exchange interactions, J_{AB}, J_{BB}, and J_{AA}, quite different ground state configurations are possible. The interpretation of our results are consistent with the configurations of Neel, Lyons et al., and Yaffet and Kettel for neutron diffraction measurements although there is some discrepancy between the NMR measurements of the spiral cone angles in $MnCr_2O_4$ and the fit of the Lyons et al. spiral to the neutron diffraction data. Dissert. Abstr.

N68-22359 Rensselaer Polytechnic Inst., Troy, N. Y.

ELECTRIC FIELD GRADIENT: ELASTIC STRAIN AND TENSOR COMPONENTS IN SODIUM CHLORIDE AND SODIUM BROMIDE

Joseph Lowry Marsh, Jr. (Ph.D. Thesis) 1966 105 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-4186

The primary purpose of this investigation was to study the effects of elastic strain on the nuclear electric quadrupole interaction in sodium chloride and sodium bromide. These effects are best described by a tensor of fourth rank, S, connecting the field gradients with the elastic strains. With the exception of the sodium ion in NaCl, this is the first experimental determination of the S tensor for these ions by the application of static elastic strain. Oriented single crystals of these alkali halides were strained. This lowered the symmetry of the lattice and produced electric field gradients at the nuclear sites. These gradients cause a perturbation of the NMR spectra by interacting with the electric quadrupole moment of the nucleus. In the case of a [111] stress in NaCl, the Cl^{35} first order satellites were directly observable as extra bumps outside the main resonance. The field gradients were determined from the changes under strain of the recorded spectra. Dissert. Abstr.

N68-22367# Ohio State Univ. Research Foundation, Columbus.

KINETICS OF IONIZING RADIATION INDUCED REACTIONS IN ORGANIC COMPOUNDS Progress Report, 1 Aug. 1966–30 Jul. 1967

Richard F. Firestone 11 Aug. 1967 28 p refs
(Contract AT(11-1)-1116)
(COO-1116-6) CFSTI: HC$3.00/MF$0.65

Effects of temperature and the presence of air on the x-radiolysis of gaseous chloroform were studied. The dose dependence of yields of major products from radiolysis of n-pentane was determined. Pulse radiolysis of chloroform and chloroform solutions of aromatic compounds was studied. Yields of solvated electrons were determined in irradiated alcohol solutions of alkali metal halides. The formation and decay of the triplet state of biphenyl formed by the pulse radiolysis of biphenyl–acetone solutions were investigated. NSA

N68-22376# Illinois Univ., Chicago. Dept. of Chemistry.

INTERACTIONS ON METALLIC SURFACES Progress Report, 1 Feb. 1967–1 Feb. 1968

Robert Gomer 1 Feb. 1968 4 p refs
(Contract AT(11-1)-1383)
(COO-1383-1) CFSTI: HC$3.00/MF$0.65

Developments are reported for studies on: adsorption of CO on single crystal planes of W field emitters; adsorption of CO on Pt; adsorption of O on Pt; mass spectrometric measurements on desorption. NSA

N68-22405# United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center.

CARBON METER FOR SODIUM Quarterly Progress Report, 1 Apr.–30 Jun. 1967

W. Caplinger 31 Aug. 1967 26 p refs
(Contract AT(30-1)-3665)
(UNC-5187) CFSTI: HC$3.00/MF$0.65

A model was developed which quantitatively correlates the carbon meter reading with the short-time carburization of 304 stainless steel in Na. The C meter flux corresponding to that C activity necessary to initiate α to γ transformation in Fe at 1400°F was bracketed. Tests in capsules have confirmed the static pot test observations that the carburizing potential of graphite in Na is strong adjacent to the source but falls off sharply in the surrounding few millimeters. O_2 appears to enhance the carburizing effectiveness of C and C-bearing compounds, although the effect is less pronounced for the latter. Measurements of H_2 leakage rates from probes are under way. A prototype gas supply and analysis console was assembled and is currently undergoing checkout. Author (NSA)

N68-22419# General Electric Co., Philadelphia, Pa. Missile and Space Div.

MASS SPECTROMETRIC ANALYSIS OF THE PYROLYSIS PRODUCTS OF POLYMERIC MATERIALS Final Report, 18 Jul. 1966–17 Jul. 1967

Harold W. Goldstein Dec. 1967 92 p refs Prepared for Calif. Univ., Livermore
(Contract W-7405-ENG-48)
(UCRL-13332) CFSTI: HC$3.00/MF$0.65

A program was undertaken to quantitatively determine the gaseous products from the heating in vacuum of selected polymeric materials. The materials investigated during this phase of the program were Skybond 700, poly-2, 2'(m-phenylene)-5,5'-bibenzimidazole, Dow Corning Q93-029, and Union Carbide Y-3602. Small amounts of the material were polymerized in notches machined in graphite filaments and heated rapidly (several seconds) to constant temperature (in the range 400 to 1000°C) in a vacuum chamber connected to a time-of-flight mass spectrometer. The pyrolysis gases were identified mass spectrometrically during the time it took the sample to reach constant temperature and while it was maintained at constant temperature. The mass spectrometer circuitry was modified to permit scanning the mass range 1 to approximately 400 every 0.2 second. The weight of sample pyrolyzed was obtained by measurement of the weight of polymer before and after heating. The gaseous products identified from Skybond 700 are benzonitrile, toluene, aniline, benzene, carbon dioxide, ethane, nitrogen and carbon monoxide and ethylene, hydrogen cyanide, acetylene, water, ammonia, methane, and hydrogen. The products identified from poly-2, 2'(*m*-phenylene) 5,5'-bibenzimidazole are phthalonitrile, benzimidazole, benzontrile, aniline, benzene, carbon dioxide, nitrogen and carbon monoxide, hydrogen cyanide, water, ammonia, methane, and hydrogen. The products identified from Dow Corning Q93-029 are octamethylcyclotetrasiloxane, a product having a principal peak at m/e-207, water, and hydrogen; in the case of Union Carbide Y-3602 the products identified are octamethylcyclotetrasiloxane, products having principal peaks at m/e-340 and 207, carbon dioxide, and water. Author (NSA)

N68-22420# United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center.

CARBON METER FOR SODIUM Quarterly Progress Report, 1 Jan.–31 Mar. 1967

30 Jun. 1967 44 p
(Contract AT(30-1)-3665)
(UNC-5181) CFSTI: HC$3.00/MF$0.65

A series of thermal convection loop tests demonstrated a definite correlation between the carburization rate of Fe and stainless steel tabs and the C meter reading of the Na to which they were exposed. Additions of carbon-bearing materials in both loop and capsule tests shows that O_2 greatly enhances the carburizing effectiveness of elemental C in Na at 1400°F. Unstable carbides, such as of Fe and Na, are able to create a significant carburizing potential in Na without addition of O_2. Use of a second thermal convection loop awaits completion of instrumentation for measuring the performance of a H_2 removal system. Fe containing 1% Ni transmits as high a C flux as Armco iron but exhibits considerable grain growth. Fe alloys with 18 and 30% Ni are not as attractive as probe material as pure Ni. A standardized side loop is being developed to provide temperature control of the probe as part of the C meter package. Author (NSA)

N68-22421# Uppsala Univ. (Sweden). Inst. of Physics.

THE K-LEVEL ENERGY OF BERYLLIUM IN METAL, OXIDE, AND FLUORIDE

K. Hamrin, G. Johansson, A. Fahlman, C. Nordling, and K. Siegbahn May 1967 9 p refs
(UUIP-548)

The K-level of beryllium in metal, oxide, and fluoride was studied by electron spectroscopy for chemical analysis. The data were compared with those obtained by X-ray spectroscopy and with a study of the disintegration constant in electron capture of ^{7}Be in the same compounds. Author (NSA)

N68-22436# California Univ., Livermore. Lawrence Radiation Lab.

DIFFUSION PATH NETWORKS IN OXIDES

Ralph H. Condit 8 Jan. 1968 32 p refs Submitted for publication
(Contract W-7405-ENG-48)
(UCRL-70149; CONF-670625-5) CFSTI: HC$3.00/MF$0.65

An understanding of diffusion mechanisms in oxides, particularly cation diffusion, must take account of the various possible paths that an atom may follow in going from one normally occupied site to another equivalent site. Such paths may be branched and will likely include stops at metastable points along the way. Methods whereby path networks within oxides can be characterized are described and diffusion in the structures NaCl, ZnS, FeS, and BeO is discussed. Author (NSA)

N68-22457# Los Alamos Scientific Lab., N. Mex.

THE SPECTROPHOTOMETRIC DETERMINATION OF VANADIUM IN PLUTONIUM–VANADIUM ALLOYS

W. J. Baughman and G. R. Waterbury 9 Feb. 1968 5 p refs
(Contract W-7405-ENG-36)
(LA-3843) CFSTI: HC$3.00/MF$0.65

Vanadium, when present in concentrations between 120 ppM and 5% in plutonium–vanadium alloys, is measured spectrophotometrically as the vanadium(V)–N-benzoyl-N-phenylhydroxylamine (BPHA) complex following separation from 100 mg of plutonium by extraction of the complex into chloroform. The vanadium and plutonium are oxidized to their (V) and (VI) oxidation states, respectively, with fuming perchloric acid. The vanadium(V) is extracted from 2.8 to 4.2M hydrochloric acid into chloroform containing BPHA, and the absorbance of the organic phase is measured at a wavelength of 530 mμ. At this wavelength, the molar absorptivity of the vanadium–BPHA complex is 4,260. Based on 14 determinations each of 12, 30, 60, 120, and 225 μg (120, 300, 600, 1200, and 2250 ppM) of vanadium, the relative standard deviations of the method are 3.5, 2.3, 1.7, 1.2, and 0.9%, respectively. Of 58 ions tested, 26 interfere when present in 100-mg quantities; at the 1-mg level, only Cr^{3+}, Mn^{2+}, Nb^{5+}, Pt^{2+}, Sn^{4+}, Ta^{5+}, Ti^{3+}, and WO_4^{2-} interfere. Author (NSA)

N68-22473# Idaho Nuclear Corp., Idaho Falls.

VERSATILE SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF MICROGRAM AMOUNTS OF MERCURY

F. Fullerton and S. S. Yamamura Jan. 1968 22 p refs
(Contract AT(10-1)-1230)
(IN-1159) CFSTI: HC$3.00/MF$0.65

A method is presented for the determination of mercury in a variety of inorganic and organic samples. After selected pretreatments, the mercury dithizonate complex is extracted from an EDTA-citrate medium into chloroform, the absorbance of which is measured at 495 mμ. The effects of 35 metal ions and 8 non-metal anions were studied. Only silver (I) interferes at less than a 50 to 1 molar ratio. Author (NSA)

N68-22474# Idaho Nuclear Corp., Idaho Falls.

RUTHENIUM DIOXIDE–OXYGEN–RUTHENIUM TETROXIDE EQUILIBRIUM

B. D. Penman and R. R. Hammer Jan. 1968 7 p refs
(Contract AT(10-1)-1230)
(IN-1013) CFSTI: HC$3.00/MF$0.65

The partial pressure of ruthenium tetroxide over ruthenium dioxide as a function of oxygen partial pressure was measured at 453° to 723°C, extending earlier data at higher temperatures. Best current values for $\Delta H°_{f,298}$, $\Delta F°_{f,298}$, and C_p for the oxides of ruthenium are given. Author (NSA)

N68-22535# National Bureau of Standards, Washington, D. C.
ELECTROCHEMICAL ANALYSIS SECTION: SUMMARY OF ACTIVITIES, JULY 1966 TO JUNE 1967 Annual Report
Roger G. Bates, ed. Oct. 1967 82 p refs
(NBS-TN-423; AR-3) GPO: $0.50

This survey of the activities of the Electrochemical Analysis Section covers the period July 1966 to June 1967. A description of facilities and equipment is presented, and the directions of the programs are indicated. Brief summaries of several lines of work now under way are given. The main areas include the measurement of acidity, with progress toward the establishment of standards for pH, pH*, and pD being reported. Studies of the behavior of glass electrodes in deuterium oxide are described and solvent effects on ionic processes are discussed. Equilibrium data for certain ionic systems have been obtained, modifications of a precision conductance bridge are described, and a method for titrating hydrogen fluoride in dimethylformamide is outlined. The survey concludes with lists of the members of the Section staff, publications and manuscripts produced during the year, talks given by the staff, and committee assignments. Author

N68-22565*# Idaho State Univ., Pocatello. Dept. of Chemistry.
THE REACTIONS PERTAINING TO ZINC-SILVER AND CADMIUM-SILVER BATTERIES Quarterly Report, Period Ending 15 Mar. 1968
G. Myron Arcand 15 Mar. 1968 19 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951887)
(NASA-CR-94382; QR-4) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Tracer studies have demonstrated that electrochemical oxidation of zinc and cadmium in 10 VF KOH solutions produces a zinc product which is less than 5% $Zn(OH)_2$ and a cadmium product which is 50–80% $Cd(OH)_2$. Oxidation of cadmium in a Cd–AgO cell containing a tritiated electrolyte solution results in a decrease in solution activity which cannot be accounted for simply by the formation of $Cd(OH)_2$. The rates of decomposition of AgO and Ag_2O apparently depend on how the original materials are prepared. These rate differences are very pronounced for Ag_2O at temperatures between 320° and 420°C and are real, though smaller, for AgO at 160°C. A procedure has been established for determining silver in KOH solutions by liquid scintillation counting using ^{110m}Ag as a tracer. Author

N68-22580*# Scripta Technica, Inc., Washington, D. C.
FREE AMINO ACIDS IN THE SOIL
T. M. Ivashkevich, V. F. Kupprevich, and T. A. Shcherbakova Washington NASA Feb. 1968 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR, v. 6, no. 8, 1962 p 523–526
(Contract NASw-1694)
(NASA-TT-F-11498) CFSTI: HC $3.00/MF $0.65 CSCL 06A

Introductory data are presented on soil amino acids in the free state with respect to the root nutrition of plants. The laboratory techniques used for extraction of soil amino acids are briefly discussed. It is reported that glutamic acid was found to be the most abundant, followed by glycine and threonine in samples collected from cultivated, low moor, peat-bog soils in the Brest Oblast and from uncultivated soils at the Minsk Bog Station. Tables are presented which describe the sample, the date of determination, and the specific amino acids extracted. E.J.S.

N68-22599# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THE WASHOUT OF METHYL IODIDE BY HYDRAZINE SPRAYS. PART A: CHEMICAL STUDIES OF THE METHYL IODIDE-HYDRAZINE SYSTEM. PART B: SPRAY DEMONSTRATION EXPERIMENTS Progress Report
L. L. Burger, R. A. Hasty, L. C. Schwendiman, J. Mishima, and A. K. Postma 1 Dec. 1967 94 p refs
(Contract AT(45-1)-1830)
(BNWL-530) CFSTI: HC $3.00/MF $0.65

The potential value of hydrazine as a reactive additive to sprays for removing methyl iodide from reactor containment atmospheres was investigated along two lines. The first was a study of the basic physical chemistry and kinetics of the reaction; the second was a study of spray removal efficiency. The gas-phase reaction was relatively slow; only 10% of the methyl iodide vapor reacted in over one hour in a large excess of hydrazine vapor. The removal rate of methyl iodide from a gas phase to a stagnant pool of hydrazine in a small-scale apparatus was established as a function of surface area of the pool, vapor space, and hydrazine concentration in solution. The homogeneous liquid-phase reaction if of great interest for spray models and the measured reaction rate constant was found to be the order of 3×10^{-2} liter $mole^{-1}$ sec^{-1}. Some criteria helpful in evaluating compounds for use as a spray additive are discussed. Author (NSA)

N68-22603# Royal Aircraft Establishment, Farnborough (England).
MASS SPECTRA AND PYROLYSIS OF SOME AROMATIC-FLUOROALIPHATIC COMPOUNDS
J. L. Cotter Oct. 1967 14 p refs
(RAE-TR-67251) CFSTI: HC $3.00/MF $0.65

The mass spectra of 13 aromatic-fluoroaliphatic compounds of the general formula $m\text{-}RC_6H_4\text{-}[CH_2]_n\text{-}C_6H_4R\text{-}m$, (R = H, CH_3, NH_2, I, OCOCl, OCH_3, OH, and $OCOCH_3$ for n = 3; and R = H, NH_2, NO_2, and Br for n = 5), perfluoro-1,3-diphenylpropane, and 1,3-bis(3-pyridyl)hexafluoropropane are reported and discussed. The products of the thermal decomposition of three of these compounds were examined by mass spectrometry, and at 515°C the order of thermal stability was $C_6F_5\text{-}[CF_2]_3 \cdot C_6F_5 < C_6H_5 \cdot [CF_2]_3 \cdot C_6H_5 < C_6H_5 \cdot [CF_2]_5 \cdot C_6H_5$. Author (ESRO)

N68-22613# Commissariat a l'Energie Atomique, Grenoble (France).
SYNTHESIS AND STUDY OF PYRROLIDINIC NITROXIDE FREE RADICALS. PREPARATION OF A NITROXIDE-TYPE STABLE BIRADICAL [SYNTHESES ET ETUDES DE RADICAUX LIBRES NITROXYDES PYRROLIDINIQUES. PREPARATION D'UN BIRADICAL STABLE OU TYPE NITROXYDE]
Rose-Marie Dupeyre Dec. 1967 111 p refs In FRENCH
(CEA-R-3176) CFSTI: HC $3.00/MF $0.65

These radicals are obtained by oxidation with hydrogen peroxide, of pyrrolidinic amines prepared from triacetonamine by ring contraction. The UV, IR and EPR spectral characteristics have been determined. The oxidation of these amines with hydrogen peroxide has led also to rupture of the pentagonal ring; some of the decomposition products have been identified. The high chemical stability of the nitroxide group has made it possible to synthesize and study a stable biradical. Author

N68-22623# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Heisse Chemie.
DISTRIBUTION CHARACTERISTICS OF PU(4) AND U(6) AND THEIR MATHEMATICAL DETERMINATION IN METAL NITRATE-NITRIC ACID AND TRIBUTYL PHOSPHATE SYSTEMS [VERTEILUNGSDATEN FUER PU(4) UND U(6) UND DEREN RECHNERISCHE ERMITTLUNG IM SYSTEM METALLNITRAT-SALPETERSAEURE UND TRIBUTYLPHOSPHAT]
W. Ochsenfeld, H. Schmieder, G. Baumgaertel, and E. Kuhn Sep. 1967 22 p refs In GERMAN
(KFK-671; EUR-3703.D)

From a great number of experimentally determined distribution data and from literature values, a theoretical equation was established for calculation of the distribution coefficients of U(VI) and Pu(IV) between HNO_3 and TBP-dodecane systems. The calculated and experimental values agreed over wide concentration ranges. The calculations were carried out with the IBM 7074. Author (NSA)

N68-22624# Mound Lab., Miamisburg, Ohio.

THE CARBONYL PROCESS AND THE EVAPORATION PROCESS FOR THE DETERMINATION OF PHASE EQUILIBRIA IN THE TEMPERATURE RANGE OF LOW MOBILITY, WITH IRON-NICKEL ALLOYS AS EXAMPLE

Theo Heumann and Gerhard Karsten Muenster 30 Jan. 1968 24 p refs Transl. into ENGLISH from Arch. Eisenhuettenw. (Germany), v. 34, 1963 p 781-785
(MLM-1381(tr)) CFSTI: HC$3.00/MF$0.65

Processes are described, which make possible the establishment of equilibria of alloy phases in a temperature range where diffusion no longer takes place. The first uses gaseous carbonyls of iron and nickel in various proportions. The gaseous mixture is decomposed on a suitable carrier at the desired temperature. It is possible in this way to arrive at equilibria between 230 and 360°C. In the second procedure the components of an alloy melt are allowed to evaporate and the mixed vapors are condensed on a suitable collector. The latter procedure, in the case of iron-nickel alloys, leads to equilibrium only above approximately 370°C. The results show that the alloys of the γ phase decompose. The eutectoid equilibrium, γ(52 atom % Ni) → α_1 6.5 atom % Ni + ($FeNi_3$) (62.5 atom % Ni) is at 345°C. Above this temperature, the values agree fully with those of Owen and co-workers. Author (NSA)

N68-22633# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.

PURIFICATION AND PELLETIZATION OF SULFUR FOR NEUTRON DOSIMETRY

R. D. Rivers and C. A. Kienberger 1 Feb. 1968 25 p refs
(Contract W-7405-ENG-26)
(K-1720) CFSTI: HC$3.00/MF$0.65

Techniques were developed for purifying and pelletizing elemental sulfur, for application in neutron detectors for area dosimetry. Purification involves the destruction of organic materials by boiling the sulfur with a small amount of magnesium oxide, distillation of the sulfur to separate it from carbonaceous matter and inorganic impurities. The product contains less than 1 ppM of the common metallic impurities and no detectable (<1 ppM) carbonaceous matter. A unique hot dispensing system was devised for precise delivery of liquid sulfur for casting of 22-gram pellets. An automatic syringe system withdraws the molten sulfur from a reservoir and delivers it to Pyrex casting rings positioned on a rotating Teflon cold plate. A hot inert gas, directed over the top surface of the pellets, melts a thin layer of sulfur, forming a smooth uniform surface. The average weight of 20 pellets, selected at random, was 22.000 g with a standard deviation of ±0.009 g per pellet. Author (NSA)

N68-22642# California Univ., Livermore. Lawrence Radiation Lab.

THE SOLUBILITIES OF TRANSITION METALS IN LIQUID ALKALI AND ALKALINE EARTH METALS, LANTHANUM AND CERIUM—A CRITICAL REVIEW OF THE LITERATURE

Donald F. Anthrop 20 Sep. 1967 92 p refs
(Contract W-7405-ENG-48)
(UCRL-50315) CFSTI: HC$3.00/MF$0.65

A critical review of the literature on solubilities of transition metals in liquid alkali and alkaline earth metals, cerium, and lanthanum is presented. The work of each investigator is described and his results are given. Solubility data are presented in graphical form as plots of log X vs 1/T, where X is the mol fraction of solute metal in the liquid metal solution, and partial molal heats of solution for the solute metals are calculated. Conclusions are presented where warranted by the existing data. Effects of impurities on solubilities of solute metals in liquid metals are discussed and some conclusions are reached from the available data. Those areas in which further research is most urgently needed are outlined. Author (NSA)

N68-22650# Royal Aircraft Establishment, Farnborough (England).

POLYDIMETHYLSILOXANES MODIFIED BY THE INTRODUCTION OF DINEOPENTYLENE PHOSPHONATE GROUPS

M. A. H. Hewins and I. M. White Apr. 1967 51 p refs
(RAE-TR-67073) CFSTI: $3.00

Poly[tetramethyl-(dineopentylene phosphonate)disiloxanes], $[SiMe_2 \cdot CH_2 \cdot CMe_2 \cdot CH_2O \cdot P(O)(R) \cdot OCH_2 \cdot CMe_2 \cdot CH_2 \cdot SiMe_2O]_n$ (I), where R = Me or Ph, have been prepared by the thermal polycondensation of the corresponding disilanols. Copolymers with R = Me and having more $-SiMe_2O-$ groups were likewise prepared. Other possible polymerisation routes proved unsuccessful; phosphonate-modified silicon derivatives showed a marked reluctance to take part in heterofunctional polycondensations. Polymers (I) are viscous syrups or gums of relatively low molecular weight and thermal stability, decomposition starting at about 220°C in air and 240°C in nitrogen, with a steep weight loss curve. Cleavage of C-O-P bonds is indicated. The polymers are markedly hygroscopic. Details of the synthesis of the polymer precursors are included. Author

N68-22705# Los Alamos Scientific Lab., N. Mex.

MASS SPECTROMETRIC INVESTIGATION OF THE COMPOSITION OF VAPOR OVER THE TiC-C AND ZrC-C SYSTEMS

T. S. Starostina, L. N. Sidorov, P. A. Akishin, and N. M. Karasev [1967] 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Neorg. Mater., v. 3, 1967 p 727-728
(LA-tr-67-91) CFSTI: HC$3.00/MF$0.65

An MS-1 mass spectrometer, modified to meet the requirements of high-temperature thermodynamic studies, was used to investigate the composition of the vapor over TiC-C and ZrC-C systems. In the TiC-C system, Ti^+, C_2^+, and C_3^+ ions were detected. From the temperature dependence of the Ti^+ ion current, the heat of sublimation of Ti from the TiC-C system was found to be 155.9 ± 7.9 kcal/mole. The Ti vapor pressure over this system at 2500°K was 1.0×10^{-3} mm. The free energy of formation of TiC from the elements was calculated to be −34.4 kcal/mole. The vaporization occurs as follows: $TiC_s \rightarrow Ti_{gas} + C_{graphite}$. In the ZrC-C system, the heat of sublimation of Zr for two series of experiments was found to be 141.2 ± 3.1 and 145.4 ± 4.2 kcal/mole. The Zr vapor pressure at 2000°K is 3.7×10^{-6} mm. Zr^+, C_2^+, C_3^+, and ZrC_2^+ ions were recorded in the mass spectrum at 2660°K. The free energy changes in the reactions $ZrC_{2gas} \rightarrow Zr_{gas} + C_{2gas}$ and $ZrC_s \rightarrow Zr_1 + C_s$ were found to be −26.0 and −38.2 kcal/mole, respectively. Small quantities of ZrC_2 molecules are shown to be present in the saturated vapor over the ZrC-C system in addition to Zr, C, C_2, and C_3. NSA

N68-22719# National Lead Co. of Ohio, Cincinnati.

DETERMINATION OF FLUORIDE IN THORIUM SOLUTIONS

R. F. Bohlander 18 Sep. 1967 14 p refs Presented at the Natl. Lead Anal. and Phys. Testing Symp., Niagara Falls, N. Y., 5-6 Oct. 1967 and at the 11th Conf. on Anal. Chem. in Nucl. Technol., Gatlinburg, Tenn., 10-12 Oct. 1967
(Contract AT(30-1)-1156)
(NLCO-1004; CONF-671052-1; CONF-671012-4) CFSTI: HC $3.00/MF$0.65

A method was developed for determination of micro concentrations of fluoride in acid solutions of thorium nitrate. The determination can be performed in 30 minutes. The fluoride could be successfully and quickly distilled from 15M phosphoric acid using a modified version of the Willard-Winter still. Thorium does not precipitate if the solution is left strongly acid. Following the distillation, micro quantities of fluoride were measured spectrophotometrically, employing the eriochrome cyanine R-zirconium lake. The results showed a high degree of precision. Author (NSA)

N68-22751# Bureau of Mines, Pittsburgh, Pa.
HEALTH AND SAFETY RESEARCH AND TESTING CENTER. DUST EXPLOSIBILITY OF CHEMICALS, DRUGS, DYES, AND PESTICIDES
Henry G. Dorsett, Jr. and John Nagy May 1968 26 p refs
(BM-RI-7132)

Dust explosion data obtained in laboratory tests by the Bureau of Mines are presented for 73 chemical compounds and mixtures, 29 drugs, 27 dyes, and 46 pesticides. Information is given on ignition temperatures of cloud and layer, minimum igniting energy, minimum explosive concentration, percent of inert dust required to prevent flame propagation, limiting oxygen concentration in the atmosphere to prevent ignition, and pressures and rates of pressure rise at dust concentrations of 0.1, 0.2, 0.5, 1.0, and 2.0 ounces per cubic foot. Explosibility indexes are computed where data are available to permit comparison of the relative explosion hazard. Variations of explosibility parameters with chemical composition are discussed. General means for minimizing the dust explosion hazard are reviewed. Author

N68-22752*# Catalyst Research Corp., Baltimore, Md.
TEST EVALUATION OF FUEL CELL CATALYSTS Final Report
H. J. Goldsmith, J. R. Moser, and T. Webb 15 Feb. 1968 16 p refs
(Contract NASw-1577)
(NASA-CR-94403) CFSTI: HC$3.00/MF$0.65 CSCL 07D

The objective was to test materials as anodic catalysts for ammonia in alkaline electrolytes and carbon monoxide in acidic and aqueous carbonate fuel cell electrolytes. A total of 54 samples consisting of carbides, nitrides, borides, nitrocarbides, carbonitrides and Raney alloys of iron, cobalt, and nickel were tested. Corrosion potentials were run to determine usable electrolyte and catalyst combinations. Surface areas measured by double layer capacitance ranged from 27.1 cm^2/gm to 117,000 cm^2/gm. In general the areas were found to be carbides > nitrocarbides > metals > borides, and for the metallic moiety silver > nickel ≅ cobalt >> iron. Voltammograms at 25°C under approximately steady-state conditions were run in electrolytes compatible with the materials. Results showed the best materials were less than 2% of the activity obtainable with platinum for the same fuel. When ammonia was the fuel, activity followed the trend: carbides ≅ nitrocarbides >> metals and nickel >> cobalt ≅ silver >> iron. Carbon monoxide activity was generally nitrocarbides >> metals > carbides > borides with silver > nickel > cobalt > iron. With only one exception, the 16 best materials of the 29 tested in acetate buffer contained nickel. Author

N68-22753# Bureau of Mines, Salt Lake City, Utah. Metallurgy Research Center.
MEASUREMENT OF OLEIC ACID ON MINERAL SURFACES USING A GAS-LIQUID CHROMATOGRAPH
Jerry L. Huiatt, J. Vance Batty, and B. F. Andrew May 1968 25 p refs
(BM-RI-7135)

An accurate and reproducible procedure was developed using the gas-liquid chromatograph to quantitatively measure oleic acid on flotation products and in flotation water phases. The method comprised extraction of the oleic acid from the mineral surfaces with alcoholic NaOH, esterification of the extracted oleate, and chromatography of the methyl ester with an internal standard. Quantitative analysis of oleic acid on flotation products from test tube and bench-scale flotation tests with pure minerals and with natural ores proved the applicability of the method on a variety of minerals. The accountability of oleic acid added was 100 percent, ±5 percent. Author

N68-22761# Commissariat a l'Energie Atomique, Saclay (France).
DIRECT DETERMINATION OF ENTHALPIES OF SOLID PHASE REACTIONS BY IMMERSION METHOD [DETERMINATION DIRECTE DES ENTHALPIES DE REACTION EN PHASE SOLIDE PAR UNE METHODE DE PLONGEE]
Andre Roux, Marc Richard, Lucien Eyraud, Moncilo Stevanovic, and Jean Elston Nov. 1967 25 p refs In FRENCH
(CEA-R-3308) CFSTI: HC$3.00/MF$0.65

It is not generally possible to measure the enthalpy change corresponding to solid phase reactions using the dynamic differential thermal analysis method because these reactions are usually too slow at the temperature of operation of present equipment. A ballistic differential thermal analysis apparatus has been developed which is based on an immersion-compensation method; it overcomes the difficulties previously encountered. This apparatus has been used after calibration for determining the enthalpies of formation of calcium and cadmium titanates, and also the Wigner energies of BeO, MgO, and Al_2O_3 samples irradiated at various doses and at temperatures below 100°C. Author

N68-22762# Commissariat a l'Energie Atomique, Saclay (France).
STUDY OF THE DIFFUSION OF SOME ELEMENTS IN MAGNESIUM [L'ETUDE DE LA DIFFUSION DE QUELQUES ELEMENTS DANS LE MAGNESIUM]
Krishan Lal (Ph.D. Thesis—Paris Univ.) 1967 54 p refs In FRENCH
(CEA-R-3136) CFSTI: HC$3.00/MF$0.65

The constants characterizing the diffusion of cerium, lanthanum, silver, zinc, and indium in polycrystalline magnesium were determined from experiments on multiple phases (Ce, La) or from infinite dilution measurements using radio-tracers (Ag, Zn, In). The results obtained can be expressed as follows: cerium: $D = 450 \exp(-42000/RT)$; lanthanum: $D = 2.2.10^{-2} \exp(-24400/RT)$; silver: $D = 0.34 \exp(-28500/RT)$; zinc: $D = 0.41 \exp(-28600/RT)$; indium: $D = 0.052 \exp(-28400/RT)$. A theoretical interpretation of the results is proposed using elastic and electrostatic models. Author

N68-22771# Commissariat a l'Energie Atomique, Saclay (France).
SULPHUR TETRAFLUORIDE SF_4 [LE TETRAFLUORURE DE SOUFRE SF_4].
Pierre Boissin and Maurice Carles Dec. 1967 32 p refs In FRENCH; ENGLISH summary
(CEA-BIB-98) CFSTI: HC$3.00/MF$0.65

This monograph on sulfur tetrafluoride contains data published until December 31, 1966 concerning the physical and chemical properties of this compound. Author

N68-22832# California Univ., Livermore. Lawrence Radiation Lab.
PREPARATION AND SOME PROPERTIES OF RARE EARTH PHOSPHIDES
G. V. Samsonov, L. L. Vereykina, S. N. Endrzheevskaya, and N. N. Tikhonova [1967] 10 p refs Transl. into ENGLISH from Ukr. Khim. Zh. (USSR), v. 32, 1966 p 115-118
(UCRL-TRANS-10222) CFSTI: HC$3.00/MF$0.65

Preparation and physicochemical properties of rare earth phosphides were studied, and it was shown that the rare earth phosphides are formed by reactions of phosphine with the metals or oxides. Recommended temperatures for preparation of rare earth phosphides from oxides are for NdP and SmP, 1300° to 1350°C; for LaP, 1200° to 1250°C; and from metals for NdP, 1000° to 1100°C, and for SmP 900° to 950°C. The prepared phosphides were easily dissolved in water. NSA

N68-22857# Kentucky Univ., Lexington. Dept. of Chemistry.

PROPERTIES AND STRUCTURES OF SOLVATES OF METAL CHELATES ENCOUNTERED IN SOLVENT EXTRACTION SYSTEMS Progress Report, 1 Jan.–31 Dec. 1967

William F. Wagner and Donald E. Sands 16 Jan. 1968 11 p
(Contract AT(40-1)-2124)
(ORO-2124-12) CFSTI: HC$3.00/MF$0.65

Structures of monohydrates of rare earth trisacetylacetonates are being studied. Some data are given for the Y, Pr, Yb, and La compounds. A structural investigation is also in progress on the hexaflouroacetylacetonate chelate salt $NH_4(C_5F_6HO_2)_4 \cdot H_2O$. Stability constants of rare earth acetylacetonates are being calculated from solvent extraction data. The attempted synthesis of rare earth chelates of 4-amino-3-penten-2-one failed. NSA

N68-22872# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

ISOMER SHIFTS IN NEPTUNIUM COMPOUNDS

J. A. Stone and W. L. Pillinger Sep. 1967 17 p refs Presented at the Faraday Soc. Conf. on the Mossbauer Effect, London, 12–13 Dec. 1967
(Contract AT(07-2)-1)
(DP-MS-67-82; CONF-671201-1) CFSTI: HC$3.00/MF$0.65

Characteristic isomer shift ranges were measured for several valence states of neptunium, using the Mössbauer resonance of the 59.54-keV gamma ray of ^{237}Np. Isomer shifts were observed for various neptunium compounds as absorbers, with an ^{241}Am-Th alloy as a single-line source, and for the charge states produced by alpha decay of various ^{241}Am compounds as sources, with a single-line NpO_2 absorber. Approximate shifts for the 0, 3+, 4+, 5+, and 6+ valences of neptunium are, respectively 0.0, +4.1, +0.2, −1.5, and −3.5 cm/sec, with respect to NpO_2. These data show that the fractional change in nuclear deformation is negative and that the excited- and ground-state quadrupole moments are equal to within 1%. The unusually larger isomer shifts observed, spanning more than 2000 natural line-widths, offer an extremely sensitive method for investigating chemical bonding in neptunium-containing systems. Author (NSA)

N68-22881# Cornell Univ., Ithaca, N. Y. Dept. of Chemistry.

MECHANISMS OF ACID-BASE CATALYSIS AND STUDIES IN DEUTERIUM OXIDE AS SOLVENT Technical Progress Report, 1 Jan. 1966–31 Dec. 1967

28 Dec. 1967 5 p
(Contract AT(30-1)-1725)
(NYO-1725-28) CFSTI: HC$3.00/MF$0.65

In an effort to explain puzzling rate data in the decarboxylation of azulene-1-carboxylic acid, the protonation of the molecule and the decarboxylation at various acidities were studied. NMR spectra confirmed protonation occurred on the carbon at the 3-position of the azulene ring. In dilute solution of a strong acid such as perchloric, at concentration of from 0.001 to 0.03M, the reaction was acid catalyzed; however, at a slightly higher acidity, 0.06 to 0.3M perchloric acid, the reaction was independent of acid concentration. Deuterium solvent isotope effects support the proposed mechanism. A study of base-catalyzed removal of proton from a carbon base acid, cyanocarbon acids that are essentially hydrocarbons in which certain CH entities are made relatively acid by the presence of nearby cyano groups, was made. Extensive study was made with 1,4-dicyano-2-butene. The base catalyzed reaction of β-ketones is being studied for further evidence on "medium effects." NSA

N68-22890*# Idaho State Univ., Pocatello. Dept. of Chemistry.

THE REACTIONS PERTAINING TO ZINC-SILVER AND CADMIUM-SILVER BATTERIES

G. Myron Arcand 15 Sep. 1967 20 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951887)
(NASA-CR-94393; QR-2) CFSTI: HC $3.00/MF $0.65 CSCL 07D

A cell for the electrochemical preparation of tagged precipitates of Zn(II) and Cd(II) was fabricated. Electrochemically-prepared AgO is 50% converted to Ag_2O in 24 hours when heated at a constant 130°. Conversion is 84% and 90% complete at 140° and 150°, respectively, in the same time. The maximum solubility concentration of Ag(I) is $4–5 \times 10^{-4}$ VF in 10 VF KOH for both AgO and Ag_2O. The concentration in the AgO system decreases slowly with time. The solubility of Ag_2O depends on the KOH concentration and shows a maximum at about 5 VF KOH. Author

N68-22904# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France).

KINETIC STUDY OF HEXAVALENT PLUTONIUM REDUCTION BY HYDROGEN PEROXIDE IN ACID SOLUTION [ETUDE CINETIQUE DE LA REDUCTION PAR LE PEROXYDE D'HYDROGENE DU PLUTONIUM HEXAVALENT EN SOLUTION ACIDE]

Bernard Lesigne Dec. 1967 36 p refs In FRENCH
(CEA-R-3168) CFSTI: HC$3.00/MF$0.65

The kinetics of the reduction of hexavalent plutonium by hydrogen peroxide were studied in perchloric, sulphuric, and nitric acids. The rate of reduction is proportional to the initial concentrations of plutonium and of hydrogen peroxide and is inversely proportional to the acidity. The values of the proportionality constant k have been determined; they are very dependent on the temperature, on the ionic force, and on the nature of the anion of the acid medium. An interpretation is put forward, based on the experimental results, attributing an important role to the hydrolized species $PuO_2(OH)+$ in the reduction kinetics. Author

N68-22911# Royal Aircraft Establishment, Farnborough (England).

THE CROSS-LINKING AND CHARACTERISATION OF PHENYL CONTAINING SILICONE RUBBERS

Edna Kay and D. K. Thomas Aug. 1967 25 p refs
(RAE-TR-67182; NP-17265)

Acceptable levels of cure can be achieved in phenyl methyl silicone rubbers by the use of organic peroxides or high-energy irradiation. With peroxides the efficiency of the crosslinking reaction is very low, and therefore high concentrations of reagent must be used. Irradiation with β or γ rays is an attractive method because of the linear relationship that exists between crosslink density and integrated dose. Using irradiation techniques it is possible to achieve any desired level of crosslinking in a controlled manner. Characterisation of phenyl silicone vulcanisates is readily carried out by solvent swelling methods. Author (NSA)

N68-22917# Argonne National Lab., Ill.

PREPARATION OF NEPTUNIUM AND PLUTONIUM IN THE 7-VALENT STATE

N. N. Krot and A. D. Gel'man Feb. 1968 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 177, 1967 p 124–126
(ANL-TRANS-574) CFSTI: HC$3.00/MF$0.65

The existence of a possibly unstable heptavalent state of neptunium appears to be quite probable in view of the fact that there is only one 5f electron in the neptunium ion. Experiments were carried out to obtain Np(VII) by the action of ozone on hexavalent neptunium in alkaline media. Passage of ozone through a suspension of sodium or potassium neptunate in 0.5 to 3.5M alkalies results in the dissolution of the solid and the formation of a brilliant green solution. The absorption spectrum of these solutions exhibits bands with maxima at 412 and 625μ; the coloration follows the Lambert–Beer's law; it is practically independent of the alkali concentration or the duration of the ozone treatment. Addition of acids results in the immediate disappearance of the green color.

It was concluded that the Np(VI) is oxidized in alkaline media to the heptavalent state and dissolves, forming the colored anion. Similar results were obtained with plutonium. The heptavalent plutonium solutions are unstable, probably because Pu(VII) is formed by the spallation of one of the two 5*f* electrons of Pu(VI).

N68-22931# Battelle Memorial Inst., Columbus, Ohio.
STUDIES OF OFF-GAS FILTER PLUGGING IN THE PRIMARY REACTOR OF THE FLUIDIZED-BED FLUORIDE VOLATILITY PROCESS
Paul D. Miller, Elmer F. Stephan, and Walter K. Boyd 19 Feb. 1968 17 p refs
(Contract W-7405-ENG-92)
(BMI-X-490) CFSTI: HC$3.00/MF$0.65

In tests of materials for the FBFVPP (Fluidized-Bed Fluoride Volatility Process Plant), plugging of nickel Feltmetal off-gas filters was found, primarily during simulated decladding. To determine the cause of plugging, a 0.5-in.-ID reactor was constructed with downstream nickel Feltmetal filters, and used to investigated filter plugging resulting from single or combined decladding variables: namely, HCl, alumina heat exchange bed, and the products of the HCl–Zircaloy-2 reaction. HCl–nitrogen caused severe plugging at 350, 400, and 450°C. Plugging decreased with decreasing temperature. Plugging was caused by the formation of $NiCl_2$ in the body of the filter. HCl corroded nickel at an overall rate of 0.5 mil per month under decladding conditions. Zircaloy-2 dissolution by HCl–nitrogen at 400 and 365°C in a fluidized bed of alumina also resulted in severe plugging. Apparently, deposition of nonvolatile fines (largely ZrO_2) on the filter surface caused the loss of porosity. Slight plugging resulted from the sweeping of alumina fines to the filter surface. Possible means of reducing plugging are suggested and possible alternative filtration is discussed. Author (NSA)

N68-22958# United Kingdom Atomic Energy Authority, Harwell (England).
OPTICAL ABSORPTION AND PHOTOCHEMICAL BEHAVIOUR OF SH', S', AND S'' CENTERS IN KCl CRYSTALS
F. Fischer and H. Gruendig May 1967 14 p refs Transl. into ENGLISH from Z. Physik (Berlin), v. 184, 1965 p 299–309
(NP-TR-1614)

The optical absorption and photochemical properties of SH' centers, analogous to OH' centers, found in polycrystalline KCl solidified from a sulfur-containing melt were investigated. It is shown that the SH' centers can be quantitatively converted into new secondary centers by photochemical reactions and by reduction with excess K. These secondary centers are interpreted as S' and S'' centers. NSA

N68-22965# Colorado State Univ., Fort Collins. Dept. of Chemistry.
CHEMICAL EFFECTS OF THE NUCLEAR REACTION $^{14}N(n,p)^{14}C$ IN VARIOUS NITROGENOUS COMPOUNDS Progress Report, 1 May 1967–30 Apr. 1968
John D. Vaughan 15 Jan. 1968 12 p refs
(Contract AT(11-1)-1620)
(COO-1620-2) CFSTI: HC$3.00/MF$0.65

The detailed chemistry of recoil ^{14}C in crystalline compounds of nitrogen is being studied. Targets include alkali azides, hydrazine dihydrochloride, and certain nitrogen heterocycles. Procedures for assay of recoil carbon products are described. NSA

N68-22975# United Kingdom Atomic Energy Authority, Harwell (England).
ALKALINE WATER pH CONTROL BY ION-EXCHANGE USING A SINGLE MIXED BED
J. Monahan and S. S. Hill Dec. 1966 19 p refs
(AERE-M-1829) CFSTI: HC$3.00/MF$0.65

It was demonstrated in the laboratory that a mixture of a strongly acidic cation resin in the ammonium, potassium, or lithium forms and a strongly basic anion resin in the hydroxyl form will maintain the pH of circuit water at any value in the range from 8.5 to 10.0 for limited periods. The use of a single mixed bed ion exchanger to maintain the pH value of an experimental loop water at approximately 9.0 and 9.5 is described. Author (NSA)

N68-22989# Commissariat a l'Energie Atomique, Saclay, (France).
PREPARATION OF RADIOACTIVE GASEOUS STANDARD [PREPARATION DES ETALONS DE GAZ RADIOACTIFS]
Maurice Blondel and Xuan Dao Phan Dec. 1967 34 p refs In FRENCH
(CEA-R-3365) CFSTI: HC$3.00/MF$0.65

To prepare a radioactive gaseous standard it is necessary on the one hand to put into a sealed vial a well-defined quantity of the gas concerned, and on the other hand to measure its specific activity. The determination of the quantity of gas which constitutes the standard implies accurate measurements of volume, temperature and pressure. To measure the specific activity, the method of compensated internal gas counters is used. The final accuracy on the specific activity of this standard is better than 0.8 percent. The validity of the method used for the measurements was checked by measuring the specific activity of the tritiated hydrogen extracted from a tritiated-water standard. Author

N68-22997# Commissariat a l'Energie Atomique, Saclay (France).
APPLICATION OF NEUTRON ACTIVATION ANALYSIS TO THE STUDY OF IMPURITIES IN MOLYBDENUM, TUNGSTEN AND NUCLEAR GRAPHITE [APPLICATION DE L'ANALYSE PAR ACTIVATION NEUTRONIQUE A L'ETUDE DES IMPURETES DANS LE MOLYBDENE, LE TUNGSTENE ET LE GRAPHITE NUCLEAIRE]
Guy Pinte Oct. 1967 79 p refs In FRENCH; ENGLISH summary
(CEA-R-3267) CFSTI: HC$3.00/MF$0.65

A neutron activation method is described for the analysis of a maximum number of foreign elements in molybdenum, tungsten and graphite. The various elements are isolated using a systematic separation program; the elements are subsequently analyzed qualitatively and quantitatively using γ-spectrometry. By this method are dosed 27 elements in molybdenum added to those elements which are already the object of routine analysis: V, Mn, Si, P, S, Cl and 14 rare earths. Author

N68-23015# California Univ., Livermore. Lawrence Radiation Lab.
BEHAVIOR OF OXYGEN IN OXIDES DURING SINTERING
Ralph H. Condit 8 Jan. 1968 22 p refs Presented at the Intern. Symp. on Kinet. of Reactions in Ionic Systems, Alfred, N. Y., Jun. 1967
(Contract W-7405-ENG-48)
(UCRL-70164; CONF-670625-4) CFSTI: HC$3.00/MF$0.65

The need for studying details of the transport mechanisms during sintering is outlined. A technique for doing this is proposed which makes use of the nuclear activation of the rare isotope of oxygen, ^{17}O, so that it can be used in effect as if it were a radioactive tracer. A test of the feasibility of the use of this as a marker in the region of neck growth between grains of ceramic material is reported. Author (NSA)

N68-23027# Commissariat a l'Energie Atomique, Saclay (France).
STUDY OF HOMOMOLECULAR ISOTOPIC EXCHANGE REACTIONS ON METALLIC OXIDES [ETUDE DES D'ECHANGE ISOTOPIQUE HOMOMOLECULAIRE SUR LES OXYDES METALLIQUES]
Jean-Claude Bailly Dec. 1967 22 p refs In FRENCH; ENGLISH summary
(CEA-BIB-104) CFSTI: HC$3.00/MF$0.65

A study has been made of the homomolecular exchange reaction for oxygen according to the equation $^{16}O_2 + ^{18}O_2 \rightleftharpoons 2\ ^{16}O\ ^{18}O$, catalyzed by metal oxides of the 3rd, 4th and

5^th^ periods of the periodic classification. The reaction occurs either with or without the surface oxygen atoms intervening; in both cases it is possible, on basis of the theory, to explain the isotopic exchange of the molecular oxygen and even to deduce the exchange mechanism. Experimental results are in agreement with the theory. The catalytic activity of oxides previously heated in oxygen at about 500°C is stable and the results are reproducible. The following classification can be drawn up for oxides of the 4th period: $TiO_2 < V_2O_5 < Cr_2O_3 < ZnO < Fe_2O_3 < CuO = NiO < MnO_2 < CoO_3$. For these oxides the homomolecular oxygen exchange and the heteromolecular exchange (oxygen exchange between the gas and the solid) take place at similar rates for a given temperature. Heating in vacuo can lead to an increase in the catalytic activity, the homomolecular exchange occurring then at temperatures lower than those required for isotopic exchange with the solid. However, the activity of these catalysts is not stable and decreases with the number of reactions. Author

N68-23039# Aerospace Corp., El Segundo, Calif.

WIDTH OF CARBON RESONANCE LINES AND IDENTIFICATION OF BANDS IN RADIATION FROM CARBON RESONANCE LAMP, MARCH–NOVEMBER 1967

A. Greenville Whittaker and Paul Kintner Dec. 1967 15 p refs
(Contract F04695-67-C-0158)
(TR-0158(3250-40)-2; SAMSO-TR-68-87; AD-666705)

The emission bands that occur in the radiation from a carbon resonance lamp in the spectral range from 1650 to 1900A were identified as part of the CO 4th positive system. A brief study was made of the source of CO and its effect on the emission. It was found that the CO may come from the reaction of graphite with oxygen introduced as an impurity in the filler gas or from oxygen or CO contained in inadequately degased graphite cathode. Large concentrations of CO cause some decrease in radiation intensity. The carbon resonance line at 1657A was also studied. There was little or no line broadening due to self absorption, and the line width of all the components of the resonance line was < 0.075A. Author (TAB)

N68-23042# Massachusetts Univ., Amherst. Polymer Research Inst.

THE ANISOTROPY OF THE POLARIZABILITY OF POLYENE SEGMENTS

Y. Shindo and R. S. Stein Feb. 1968 19 p refs Sponsored in part by NSF
(Contract Nonr-3357(01))
(ONR-TR-99; AD-666684)

The calculations of the longitudinal polarizabilities of polyenes are extended using a free-electron and Huckel-molecular orbital model in an effort to be able to predict the dependence of the birefringence of such molecules upon their orientation. Author (TAB)

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N68-21870# Kiruna Geophysical Observatory (Sweden).

CONTINUOUS MEASUREMENTS OF THE FARADAY EFFECT USING CROSSED ANTENNAE

A. Wernik Dec. 1967 15 p refs
(KGO-677) CFSTI: HC $3.00/MF $0.65

A possible method of recording the Faraday effect using crossed dipoles is presented. This enables continuous measurement of the orientation of the plane of polarization and also of its fluctuations to be made. Author

N68-21880 Kiruna Geophysical Observatory (Sweden).

ON THE AMPLITUDE DISTRIBUTION OF SCINTILLATING RADIO SIGNALS FROM ARTIFICIAL SATELLITES

A. W. Wernik (Polish Acad. of Sci.) and L. Liszka Jan. 1968 25 p refs
(KGO-682) CFSTI: $3.00

Twenty-two amplitude distributions of scintillating satellite signals are analyzed. Differences between observed and theoretical Rice distributions are explained by the existence of correlation between orthogonal components of the electromagnetic field vector of the scattered wave. Polarization effects resulting from non-uniform phase distribution are considered. Author

N68-21892*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.

FLIGHT TESTS OF A RADAR SCATTERING-COEFFICIENT MEASURING INSTRUMENT. PART 1: SUMMARY

J. F. Reintjes, J. R. Sandison, J. A. Bosco, and L. W. Counts Feb. 1968 31 p
(Grant NsG-234-61; Proj. DSR-76343)
(NASA-CR-94224; ESL-R-340, Pt. 1) CFSTI: HC $3.00/MF $0.65 CSCL 09F

A summary report of flight tests is presented. The report includes a brief description of the instrument, and its installation in the flight-test vehicle, a CV-990 aircraft. Representative values of scattering coefficients measured for normal incidence of the X-band radiation and for incidence angles of 75° and 60° angles are given. The targets chosen for illustration are water, mountainous areas, lava beds, flat land and farm land. Author

N68-21913 Texas Univ., Austin.

A STUDY OF THE ELECTROMAGNETIC SCATTERING PROPERTIES OF A METEOROLOGICAL "RADAR ANGEL" MODEL

William Neal Kocurek (Ph.D. Thesis) 1966 240 p
Available from Univ. Microfilms: HC $10.80/MF $3.10 Order No. 67-3310

The general bistatic radar cross-section of the Atlas meteorological coherent-dot radar angle model was developed by both geometrical and physical optics. The monostatic cross-section, obtained as a special case of the bistatic development, was then compared with existing experimental data. The geometrical optics study of the model yielded a relatively simple expression subject to about a five percent error over the greater part of the parameter range involved. The solution is limited however by the necessary geometrical limitation; the relative location of transmitter and receiver must be such that the receiving aperture is completely filled by energy reflected off the scatterer. The physical optics development using the Kirchoff–Huygens principle, on the other hand, yielded a more accurate cross-section not subject to the aforementioned limitations. The results of this development, however, incorporated a number of diffraction integrals requiring numerical integration. Dissert. Abstr.

N68-21921*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MODULO ACQUISITION OF AMBIGUITY RESOLVING TRACKING CODES

Solomon Levine Mar. 1968 5 p refs
(NASA-TM-X-63167; X-531-68-112) CFSTI: HC $3.00/MF $0.65 CSCL 17I

In a sidetone ranging system, acquisition is accomplished easily by means of phase locked loops; in a pseudo-random coding system, it requires a series of operations. The received code and the local model must be driven by the same clock, and the local model shifted bit by bit with respect to the received code until correlation is obtained. In a hybrid system which uses both sidetones and pseudo-random codes, it is possible to use the ambiguous sidetone range measurement for an automatic and rapid acquisition of the received pseudo-random code. As compared to the code only systems, the modulo acquisition technique used by the hybrid system reduces the acquisition time to a mere 1.3%, increases the detection threshold by 6 db, and reduces the encoder complexity considerably. Author

N68-22019*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

OPTICAL AND MICROWAVE COMMUNICATIONS: A COMPARISON

F. Kalil Washington May 1968 46 p refs

(NASA-TN-D-3984) CFSTI: HC $3.00/MF $0.65 CSCL 17B

Some preliminary comparisons are made of microwave, millimeter, and optical communication systems for space communication from a spacecraft at Mars distances. An attempt is made to be realistic with regard to technology. Some discussion of thermal, quantum, and sky noise is included, as well as some discussion and analyses of microwave, millimeter wave, and optical technology; acquisition and tracking; and some mission analysis. Based on the considerations herein, it appears likely that in the radio spectrum, the S-Band is the better place to operate. However, it also appears likely that optical communication systems have the greater potential for higher data rates—up to about 10^8 bps at Mars distances. Author

N68-22044*# Kansas Univ., Lawrence. Remote Sensing Lab.

A STUDY OF EARTH RADAR RETURNS FROM ALOUETTE SATELLITE

R. C. Chia, H. H. Doemland, and R. K. Moore Apr. 1967 35 p refs

(Grant NsG-477)

(NASA-CR-94294; CRES-37-1) CREW-37-1) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Ionospheric topside soundings from the Alouette satellite were telemetered back to ground and recorded onto magnetic tapes. Evaluation of the sounder ionograms showed that many ionograms contained good ground radar returns from satellite altitudes in the frequency range 8.5 to 9.5 Mc/s. Analyses of ground echo reflection coefficients from the 1000 km altitude of the satellite for 70 sample points over the earth surface at 9 Mc/s frequencies established effective reflection coefficient ranges from −12 dB to −2.8 dB for land and 09.2 dB to −2.68 dB for the ocean. After first order corrections from the quiet day curve, ionospheric absorption ranged from 0.65 dB to 6.5 dB at 9 Mc/s with corrected values from −10.5 dB for the forest to −0.02 dB for the ocean. The average diurnal attenuation correction gave ranges of −5.35 dB to −0.06 dB for the ocean and −10.67 dB to −4.6 dB for land. G.G.

N68-22049 Stanford Univ., Calif.

SEQUENTIAL SIGNAL DESIGN FOR RADAR AND COMMUNICATION

Michael John Ferguson (Ph.D. Thesis) 1966 133 p

Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-4346

The research described herein is a study of the problem of designing signals for radar and communication, subject to peak- and average-power constraints, in such a manner as to enable decisions between pertinent hypotheses to be made sequentially, thus minimizing the expected time to decision. Both the radar and the communication signal design problems are characterized by the testing of two simple hypotheses, H_+ and H_-. For the radar problem, the hypothesis H_+ refers to the presence of an object in a certain location, while the hypothesis H_- refers to the absence of any such object. For the communication problem, the H_+ refers to the transmission of a binary "1," and the H_- to the transmission of a binary "0." Dissert. Abstr.

N68-22078 Stanford Univ., Calif.

A NEW MODEL FOR "IMPULSING" PHENOMENA: APPLICATION TO ATMOSPHERIC-NOISE COMMUNICATION CHANNELS

Harry Marcellus Hall, Jr. (Ph.D. Thesis) 1966 177 p

Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-4357

A new model is developed for atmospheric noise, which is radio noise that originates in lightning discharges. This model is applied to the detection of known signals in additive atmospheric noise. The modeling approach used is based on the observation that a Gaussian model is inappropriate for received atmospheric noise, primarily because Gaussian noise does not have the large dynamic range exhibited by the received noise power. The generalized "t" model resulting from the approach used is in good agreement with measured data. Dissert. Abstr.

N68-22276*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

BACKFIRE YAGI ANTENNA MEASUREMENTS

L. R. Dod Dec. 1967 52 p refs

(NASA-TM-X-63173; X-525-67-604) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Radiation patterns and gain measurements on 1.0, 1.5, and 2.0 λ backfire Yagi antennas are given. The backfire antenna was tested for two dipole feed locations, and variations in the diameters of the two planar reflectors forming the backfire cavity. The optimum dimensions of the three test antennas are tabulated. The frequency bandwidth of the backfire antenna is limited to several percent due to impedance matching. The backfire antenna should find application in broadside arrays where conventional endfire antennas are presently used. Author

N68-22277*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SST TELEMETRY SIMULATOR

R. J. Stattel and Neil E. Roberts Mar. 1968 20 p

(NASA-TM-X-63176; X-721-68-94) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The SST telemetry simulator provides an output simulating the demodulated PPM signal to the Servo Clock. Other outputs are similar to those of the Servo Clock. Clock rates of five, ten, or twenty kilohertz are selected by means of externally switched voltages to the appropriate internal relays. Author

N68-22281# Royal Aircraft Establishment, Farnborough (England).

STUDY OF BROAD-BAND AMPLITUDE-COMPARISON METHODS FOR ACCURATE MICROWAVE DIRECTION FINDING IN A SECTOR

N. A. D. Pavey Oct. 1967 48 p refs

(RAE-TR-67271) CFSTI: HC $3.00/MF $0.65

Frequency invariant aerial radiation patterns are ideally required in two-channel amplitude-comparison systems for accurate direction finding over bandwidths approaching an octave. Optimum radiation patterns are not practically realizable, but reasonable approximations to these may be synthesized using multiple narrow beams. The design of a 6-beam detector-video system for determining the angle of arrival of a single pulse signal within a 8° sector is considered and sources of D. F. error are analyzed. An overall D. F. error of 0.2° rms is estimated due to systematic effects. Voltage signal-to-noise ratios of greater than 150:1 are necessary to minimize further D. F. degradation due to thermal noise. Alternative signal processing studies are planned. Author (ESRO)

N68-22321*# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
ADMITTANCE OF THE INFINITE CYLINDRICAL ANTENNA IN A LOSSY PLASMA. 3: THE COMPRESSIBLE, MAGNETOPLASMA
Edmund K. Miller Oct. 1967 57 p refs
(Contract NASr-54(05))
(NASA-CR-94345; Rept.-05627-13-S) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Analysis of the current on an infinite cylindrical antenna which is excited across a circumferential gap of nonzero thickness and immersed in a lossy, compressible, magnetoplasma with its axis parallel to the static magnetic field, is described. Some numerical results are presented for the antenna admittance for the sheathless case, where the uniform magnetoplasma is in contact with the antenna surface. The admittance values are obtained from a numerical integration of the Fourier integral for the antenna current, and are given for plasma parameter values typical of the E-region of the ionosphere. The admittance results obtained exhibit a maximum slightly above the electron cyclotron frequency (f_h). The conductance is found to exceed the susceptance except in the frequency range encompassed by the upper hybrid frequency and f_h, which is also approximately the range of inductive susceptance, the susceptance otherwise being capacitive. The admittance is also found to exhibit a minimum or slight kink at the plasma frequency. It is concluded that of the plasma compressibility, plasma anisotropy, and the vacuum sheath, taken separately, the latter two exert the strongest influence on the infinite antenna admittance. Author

N68-22333 General Electric Co., Syracuse, N. Y. Heavy Military Electronics Dept.
COMPUTER EVALUATION OF RANGE-GATED FILTER MTI SYSTEM
D. R. Miedaner Feb. 1967 75 p refs
(R67EMH8)

This report describes the simulation and evaluation of a particular type of radar system which employs ranged-gated filters, staggered prf, noncoherent or coherent detection, and a rectifier/integrator. A detailed description of the simulator, instructions for use, results from a specific application, and the background analytical work are also included. The simulator user, having control over a large number of system and environmental parameters, can readily determine the effect of certain factors on overall system performance. Author

N68-22423*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN AIRBORNE PULSE COUNTER AND SERIAL ENCODER
John W. Fennel, Raymond J. Stattel, John F. Fitz, and Marcus L. Moore Sep. 1967 29 p
(NASA-TM-X-63172; X-721-67-469) CFSTI: HC $3.00/MF $0.65 CSCL 09F

A compact, self-contained pulse counter and serial encoder capable of counting up to 99,999 and producing a serial binary-coded decimal output is described. The unit was designed to count pulses from a digital accelerometer and produce an output, consisting of the accumulated count, every second. The output may be transmitted over a single low frequency channel of a standard FM/FM telemeter. The accumulated count is easily read from a real time analog record and is suitable for digital processing. The device leads itself to applications where the total number of pulses from a sensor is required. Author

N68-22431 General Electric Co., Philadelphia, Pa.
ANTICIPATED PROBLEMS OF RE-ENTRY VEHICLE TELEMETRY AT UHF Technical Information Series
Fred H. Numrich 26 May 1967 10 p refs
(Doc.-67SD263)

The Department of Defense has directed a change from VHF to UHF telemetry bands for R&D missile telemetry by Jan. 1, 1970. Flight test experience at VHF has demonstrated that receiving stations experience difficulty in tracking reentry vehicles under conditions of rapid changes of signal strength caused by combinations of vehicle motion, nonuniform vehicle antenna patterns, and plasma attenuation. Similar but greater variations at UHF coupled with narrow receiving beamwidths and reduced sensitivity of reentry stations portend greater problems at UHF. In addition to defining the reentry problem, system limitations, and expected effects, this report makes recommendations to range planners and users to minimize or correct the anticipated problems. Author

N68-22746*# Ohio State Univ., Columbus.
THE TEM RADIATION PATTERN OF A THIN-WALLED PARALLEL-PLATE WAVEGUIDE ANALYZED BY A SURFACE INTEGRATION TECHNIQUE
D. C. F. Wu Washington NASA May 1968 52 p refs
(Grant NsG-488)
(NASA-CR-1052; Rept.-1691-23) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The radiation pattern of a TEM mode thin-walled parallel-plate waveguide is analyzed by a surface integration technique in conjunction with wedge diffraction theory. The surface integral is obtained by the Green's second identity. The fields on the surface are calculated by plane wave diffraction and first order interactions between two edges of the guide. The surface integration technique provides an improvement in the accuracy of the pattern as compared to the wedge diffraction method. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N68-21899*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
STABILITY CRITERIA FOR THE OAO COARSE POINTING MODE, PART 2 Final Report
Samuel E. Moskowitz Nov. 1967 58 p Prepared for Grumman Aircraft Eng. Corp.
(Contract NAS2-4063)
(NASA-CR-73166; Doc.-67SD4428) CFSTI: HC $3.00/MF $0.65 CSCL 09B

A brief discussion is presented on the computing system requirements, generalized logic flow, and input variables for a FORTRAN-4 computer program written to assist in the analysis of stability criteria for the Orbiting Astronomical Observatory coarse pointing mode. Flow charts are used to identify the calculation sequence of the subroutines involved. Sample input and output data are included, and a complete listing of the program is provided. Although written for a GE-365 computer, the program may be used on any other computer capable of handling the standard FORTRAN-4 language. E.J.S.

N68-21906# Royal Aircraft Establishment, Farnborough (England).
MERCURY MINIJOSS (A SMALL-SCALE, COMPUTER MULTI-ACCESS SYSTEM): HARDWARE IMPLEMENTATION AND BASIC PROGRAM CONTROL OF INPUT/OUTPUT TRANSFERS
K. Sanderson Nov. 1967 37 p ref
(RAE-TR-67295) CFSTI: HC $3.00/MF $0.65

Hardware implementation and basic program control are considered for input/output transfers for MINIJOSS, a small-scale, computer multi-access system comprising a group of keyboard teleprinters, each of which has "independent" access to the Mercury computer. The system name is derived from JOSS (JOHNNIAC open-shop system) developed by the Rand Corporation. Author

N68-21981 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROBLEMS OF THEORY AND APPLICATION OF MATHEMATICAL MODELING

12 Sep. 1967 30 p refs Transl. into ENGLISH from Vopr. Teorii Primeneniya Mat. Modelirovaniya (Moscow), 1965 p 86–101, 268–272
(FTD-MT-66-137; AD-666242)

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N68-21982 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE USE OF ELECTRONIC DIGITAL COMPUTERS (EDC) FOR DESIGNING ANALOG COMPUTERS [O PRIMENENII ELEKTRONNYKH TSIFROVYKH VYCHISLITEL'NYKH MASHIN (ETSVM) DLYA PROYEKTIROVANIYA ANALOGOVYKH VYCHISLITEL'NYKH MASHIN]

I. B. Vaysman *In its* Probl. of Theory and Appl. of Math. Modeling 12 Sep. 1967 p 1–16 refs (See N68-21981 12-08)

The paper is devoted to application of electronic digital computers for the automation of designing electrical analog computers. The procedure in question is constructed on the basis of conditions for designing specialized EAC for the solution of one problem. However, its basic positions can be utilized in compiling a simulation circuit on universal EAC. The whole process of designing EAC is divided into six basic stages: (1) compiling a mathematical description of the problem to be solved; (2) development and design of a functional circuit, (3) development of fundamental electric circuits; (4) design and issue of operational plans; (5) development of electrical assembly and cable diagrams; (6) development of descriptions, instructions, specifications and other textual documentations. The author provides a solution for a typical problem of this type. Author

N68-21983 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INTEGRATORS OF ELECTROHYDRODYNAMIC ANALOGIES OF INDUSTRIAL PRODUCTION

P. F. Fil'chakov and V. I. Panchishin *In its* Probl. of Theory and Appl. of Math. Modeling 12 Sep. 1967 p 19–25 refs (See N68-21981 12-08)

The use of conductive paper of industrial production as a conductive medium considerably simplified the technique of simulating problems of electrohydrodynamic analogies. The use of electric conductive paper as an electric conductive medium in place of electrolytes and foils made possible the simplifying of the design of integrators and their manufacture under industrial conditions, which in turn led to a wide use of the method for solving complicated technical problems. Description of various models of integrators is included and typical uses in industry are enumerated. Suggestions for necessary improvements are proposed. Author

N68-22155# National Physical Lab., Teddington (England). Aerodynamics Div.

A COMPUTER PROGRAM FOR NON-EQUILIBRIUM CONVERGENT-DIVERGENT NOZZLE FLOW

J. L. Wilson, D. Schofield, and K. C. Lapworth 20 Oct. 1967 21 p refs
(NPL-AERO-1250, ARC-29246) CFSTI: HC$3.00/MF$0.65

A computer program is described which calculates vibrational non-equilibrium flow in arbitrary one-dimensional convergent-divergent nozzles. The program may be used with any numerically specified nozzle and any diatomic gas, including air. Results are included of calculations based on a nozzle constructed for a shock tunnel, designed to study vibrational non-equilibrium effects experimentally. Author (ESRO)

N68-22166# Wisconsin Univ., Madison. Mathematics Research Center.

MACHINE LANGUAGE PROGRAMMING FOR THE CDC 3600

J. M. Yohe Aug. 1967 170 p
(Contract DA-31-124-ARO(D)-462)
(MRC-TR-721; AD-666188) CFSTI: HC$3.00/MF$0.65

The report contains a set of notes designed to aid programmers who are familiar with FORTRAN in learning machine language programming for the CDC 3600 computer. TAB

N68-22167# National Environmental Satellite Center, Washington, D. C.

COMPUTER PROCESSING OF SATELLITE CLOUD PICTURES

C. L. Bristor Apr. 1968 14 p refs
(NESCTM-3)

The computer processing of satellite cloud pictures on a daily operational basis is described. A generalized flow of the hardware/software process is given with the aid of several logic diagrams. Author

N68-22188 Stanford Univ., Calif.

OPTIMAL ADAPTIVE SEARCH

Wesley Wei-Chin Chu (Ph.D. Thesis) 1966 148 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-4332

Optimal search strategies are developed for locating an object hidden in one of several locations. The five parameters considered in the search process are location probabilities, detection probabilities, testing cost, terminal penalty, and terminal reward for locating the object. A set of optimal adaptive-search decision-making policies can be developed that yield the minimum expected loss when the parameters are known, and the minimum expected mean loss when the parameters are not known. An ideal search policy exists such that all its truncated policies have minimum expected search cost for the known parameters, and minimum expected mean search cost for the unknown parameters. The necessary and sufficient conditions satisfied by such a policy are presented. By employing the policy constructed from these conditions, the optimal adaptive rules for terminating the search process are governed by the properties of the expected search cost function, and the terminal penalty and terminal reward for the case in which the parameters are known. Dissert. Abstr.

N68-22190# European Space Data Centre, Darmstadt (West Germany).

REDUCTION OF SATELLITE TELEMETRY DATA

W. Lloyd Paris ESRO Nov. 1966 25 p refs Presented at the ESRO Summer School, Oxford, 26 Aug. 1964
(ESRO-TM-45) CFSTI: HC$3.00/MF$0.65

The paper describes a method of producing, from the mass of data telemetered from a satellite, results sufficiently concise to be assimilated by the experimenters. This method was used in the Ariel I project, which is described in some detail. Difficulties encountered in the data processing are mentioned, and some suggestions are offered for making the data reduction in future projects more efficient. Author (ESRO)

N68-22215 Virginia Univ., Charlottesville.
THRESHOLD LOGIC MULTIFONT CHARACTER RECOGNITION SYSTEM
Rafael Madrigal Inigo (Ph.D. Thesis) 1966 162 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-3777

This dissertation considers the theory and design of a recognition type reading machine. Among the uses for such a machine would be the possibility of aiding the blind to read, and this has been a primary consideration in the work. Theoretical results are presented for the electronic part of the receptor as well as the logic section, called a categorizer, of this character recognition system. Some experimental work was done to support the theory. The complete system consists of: (1) a receptor which scans printed matter and converts printed patterns into electrical signals; (2) a categorizer which identifies the printed characters from the information in the receptor's electrical signals by means of thirty-one invariant characteristics implemented by threshold logic; the minimized Boolean expressions for the alphabetical characters are then obtained using these invariant characteristics; (3) a Braille generator which produces Braille symbols when actuated by the categorizer outputs; the Braille generator is not considered in detail. Dissert. Abstr.

N68-22373# Illinois Univ., Urbana. Dept. of Computer Science.
THE THEORY AND IMPLEMENTATION OF SRT DIVISION
Daniel E. Atkins, III (M.S. Thesis) 1 Jun. 1967 72 p refs
(Contract AT(11-1)-1018)
(Rept.-230; COO-1018-1115) CFSTI: HC $3.00/MF $0.65

A class of digital division techniques, called SRT division especially suited for implementation in an electronic digital computer is described. The theory and properties of SRT division are presented, and an example of its use is illustrated. NSA

N68-22422*# California Univ., Berkeley. Space Science Lab.
OPTIMIZATION OF DESIGN OF SPACE EXPERIMENTS FROM THE STANDPOINT OF DATA PROCESSING Semiannual Report, 1 Oct. 1967–31 Mar. 1968
Samuel Silver, David J. Sakrison, and V. Raphael Algazi 31 Mar. 1968 13 p refs *Its* Ser. 9, Issue 22
(Grant NGR-05-003-143)
(NASA-CR-94331) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Progress is summarized for a study of the computational aspects of spacecraft onboard processing of experimental data. The emphasis is on construction of an array processor designed to assist in processing the following data algorithms: inner product, matrix multiplication, correlation, convolution (time domain filtering), state-space filtering, and fast Fourier transform (Cooley–Tukey algorithm). The processor incorporates: (1) a separate register to store the output of the adder; (2) a mode of operation that allows the operands u_n and v_n to be recalled sequentially from storage; and (3) a fast multiplier, to permit the sequential recall to proceed at a rate of one recall per core cycle and to allow decreased arithmetic time. Also discussed are two problems of spacecraft data processing in the context of Shannon's source encoding theory: the effect of instrument dynamics and noise on the rate distortion function of Gaussian sources; and encoding for a class of sources. E.C.

N68-22433# Sandia Corp., Albuquerque, N. Mex.
COMPUTER PROGRAMS FOR DYNAMIC RESPONSE OF PARTIALLY NONLINEAR SYSTEMS
Walter B. Murfin Jan. 1968 29 p refs
(Contract AT(29-1)-789)
(SC-TM-67-2977) CFSTI: HC $3.00/MF $0.65

The use of a series of computer programs is described. Author (NSA)

N68-22510*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPACE SCIENCES DATA PROCESSING
George H. Ludwig Washington May 1968 19 p refs
(NASA-TN-D-4508) CFSTI: HC $3.00/MF $0.65 CSCL 09D

Spacecraft carrying large numbers of scientific instruments presently transmit data at the rate of approximately 150 million data points per day which must be converted from raw digital form into a conceptually meaningful form for analysis. The task of processing these data rapidly and accurately is a large one, done in several steps. The first step involves converting the raw receiver output signals into computer compatible digital form, including signal clean-up, establishment of synchronization, and time decoding. In the newest processing lines, this first step also includes a moderate amount of editing and quality checking. The remaining steps employ large-scale computers for further editing, establishing accurate timing, computing spacecraft attitude, and sorting to provide data tapes for individual experimenters. The experimenters are responsible, at present, for further reduction to a more meaningful form. These operations include additional sorting, storage, compilation, computation, and display. Author

N68-22610# California Univ., Livermore. Lawrence Radiation Lab.
OPEN AND CLOSED-LOOP TECHNIQUES FOR COMPUTER CONTROLLED INSTRUMENTATION Final Report
T. A. Brubaker 20 Jan. 1968 12 p refs
(Contract W-7405-ENG-48)
(UCRL-13335) CFSTI: HC $3.00/MF $0.65

Results of investigations on time domain synthesis of finite memory digital filters, time domain synthesis of infinite memory digital filters, discrete state space techniques in real time digital simulation, the effects of round-off errors in small computer implementation of finite memory filters, discrete Fourier transforms, adaptive sampling and quantization, and decision theory for data analysis are given. NSA

N68-22717# System Development Corp., Santa Monica, Calif.
SOME TECHNIQUES FOR DESCRIBING PROGRAMMING LANGUAGES
Millard H. Perstein 4 Jan. 1968 32 p refs
(SP-2916/000/01; AD-666370)

The paper examines several techniques for describing a programming language, points out desirable qualities in programming language description, and notes some incompatibilities among these qualities. Misconceptions with regard to the appropriate role of compact syntax metalanguages are pointed out. Reasons are adduced for producing a single definitive document to specify a given programming language for the edification of all programmers skilled in the art. A lean mix of compact syntax metalanguage with natural language is recommended for writing such a document. Author (TAB)

N68-22740# Northwestern Univ., Evanston, Ill.
AN EXPLICIT SOLUTION OF A SPECIAL CLASS OF LINEAR PROGRAMMING PROBLEMS
Adi Ben-Israel and Abraham Charnes Dec. 1967 17 p refs
Sponsored in part by NSF
(Contracts Nonr-1228(10); DA-31-124-ARO(D)-322)
(SRM-191; AD-663877)

The linear programs considered here are of the form: Maximize (c,x) (LP) subject to a = or < A x = or < b where A is of full row rank, and (LP) is feasible with bounded optimal solutions. The main result is an explicit representation of the general optimal solution of (LP), in terms of a generalized inverse of A. This explicit solution of (LP) - explicit in the sense that A superscript (-1) b is an explicit solution of A x = b - has obvious theoretical (and possibly computational) advantages over the well known iterative methods of linear programming. The results are illustrated by a simple example, and extensions to general linear programs are discussed. Author (TAB)

N68-22905# Illinois Univ., Urbana. Dept. of Computer Science.
THE PATTERN ARTICULATION UNIT OF ILLIAC 3: HOMOGENEOUS BOOLEAN FUNCTIONS IN THE ITERATIVE ARRAY
Bruce H. Mc Cormick, William J. Watson, and Richard T. Borovec 8 Jan. 1968 23 p ref Supported in part by ARPA
(Contract AT(11-1)-1018)
(Rept.-253; TID-24249) CFSTI: HC $3.00/MF $0.65

The Pattern Articulation Unit (PAU) of the Illiac III Computer is a modular parallel data processor for visual information. The internal data word is a plane having dimensions 32×32 bits. Planes are processed in parallel by the execution of homogeneous (plane-wide) operations. This processing is performed in an Iterative Array having an internal storage capacity of 9 planes. These 9 planes of fast registers, which in many ways serve as multiple accumulators, are augmented by 48 planes of core storage, the Transfer Memory of the PAU. The homogeneous Boolean functions evaluated in the Iterative Array, and the machine language whereby instructions for homogeneous Boolean functions are transmitted to the PAU are described. Author (NSA)

N68-23004# Chicago Univ., Ill. Inst. for Computer Research.
INSTITUTE FOR COMPUTER RESEARCH Quarterly Report
Victor H. Yngve 1 Nov. 1967 103 p refs
(Contract AT(11-1)-614)
(COO-614-59; QR-15) CFSTI: HC $3.00/MF $0.65

Developments in computer and computer programming research are briefly reported. Topics discussed include the Man–Machine project, a user's view of capabilities, simplified implementations of the EOL language, symmetrical stacks in EOL, and the UNCLLL Plex-Processing language. Also, signal-to-noise ratio in fringe visibility measurements with a michelson stellar interferometer and a scheme for studying astronomical "seeing" are described. NSA

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N68-21909# Royal Aircraft Establishment, Farnborough (England).
A SIMPLIFIED APPROACH TO THE DESIGN OF LOW-PASS ACTIVE FILTERS
T. D. Reed Sep. 1967 44 p refs
(RAE-TR-67224) CFSTI: HC $3.00/MF $0.65

A third order low-pass filter is analyzed and a standard form of the circuit is proposed which requires the selection of three component values only, two for frequency and one for damping. These values are readily determined from the graphs and formulas presented. Author (ESRO)

N68-21919*# Perkin-Elmer Corp., Norwalk, Conn. Optical Group.
FRAUNHOFER LINE DISCRIMINATOR Final Report
H. Ludwig, D. Markle, and G. Schlesinger 15 Apr. 1968 117 p
(Contract NAS9-7447)
(NASA-CR-92065; Rept.-9148) CFSTI: $3.00 CSCL 09C

Descriptions of the function, purpose, and design of the airborne Fraunhofer line discriminator are presented, along with information on component and system tests, calibration and storage, and operation and maintenance. The instrument can cope with the wide spectral differences of natural terrain and is immune to the vibration environment of the aircraft. It uses a narrow band filter located on the center of the 0.7 Å wide Fraunhofer sodium D line at 5890 Å. The required spectral resolution was achieved with a glass spaced Fabry–Perot filter which is immune to any temporal or vibration induced spectral changes. A compact optical design is used which provides for continuous sampling of the solar spectrum without a tracker or any limitations on aircraft direction. The instrument will measure concentrations of rhodamine B in aqueous solution from a low flying aircraft, but has possible applications as a prospecting tool for phosphate and fluorescent minerals, in detecting water polluted by oil, fish finding, and plant studies based on the fluorescence of chlorophyll. R.N.A.

N68-21926 California Univ., Berkeley.
INTEGRATED LOWPASS AMPLIFIERS
Arthur James Brodersen (Ph.D. Thesis) 1966 134 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-5011

Design techniques for integrated broadband lowpass amplifiers are presented. Existing designs of discrete-component amplifiers are used as vehicles to determine practical integrated realizations of broadband lowpass amplifiers. Different amplifiers are compared on the basis of broadband effectiveness and temperature sensitivity using a new scalar measure. This new scalar measure, a gain-frequency integral, is introduced to facilitate the comparison of different amplifier configurations. This gain-frequency integral is particularly useful as a measure of the temperature sensitivity of an amplifier. Feedback amplifier stages are shown to be useful as integrated broadband lowpass amplifiers. This report also investigates the use of composite-transistor stages as integrated broadband lowpass amplifier stages. Dissert. Abstr.

N68-21965 Stanford Univ., Calif.
THE FEASIBILITY OF MICROWAVE POWER TRANSMISSION USING CIRCULAR WAVEGUIDE
Walter Loewenstern (Ph.D. Thesis) 1966 91 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-4396

A cylindrical waveguide operating in the TE_{01} mode can transmit powers of the order of thousands of megawatts in frequency ranges below 10 gc/s with acceptable copper losses over distances of hundreds of miles, provided it can be made with sufficient accuracy to avoid excessive power transfer into other unwanted high-loss modes. The tolerances on the guide straightness appear to be the most severe limitation on the use of this type of guide as a high-power system component. These tolerances are evaluated and found to be of the order of 10 to 100 mils in distances of a few hundred feet for typical values of the other parameters such as 1.0 gc/s in a 2-meter-diameter guide providing one db power loss in a distance of 200 miles. Tolerances on diameter variations and cross-section ellipticity are also evaluated and found to be of the same order of magnitude as the deviations from straightness, but should be easier to control by the proper manufacturing process. It is also shown that low-loss bends (about 0.01 db/mile) with bending radii of the order of 0.5 miles are possible if the length of the bend is accurately controlled and the guide has a dielectric lining of the proper thickness. Dissert. Abstr.

N68-22016# Royal Aircraft Establishment, Farnborough (England).
A METHOD OF IDENTIFYING THE ADMITTANCE MATRIX OF JUNCTION TRANSISTORS
G. Zoldan Nov. 1967 36 p refs Transl. into ENGLISH from Alta Frequenza (Milan), v. 35, no. 10, 1966 p 819-829
(RAE-LIB-TRANS-1262) CFSTI: HC $3.00/MF $0.65

The designer of linear electronic circuits frequently has to measure the differential parameters of the transistors he intends using. Frequencies above a few MHz can usually be measured by using alternating sinusoidal methods since it is preferable to use analytical formulae which express these in terms of the variable complex s, rather than diagrams of the actual and imaginary parts of the parameters, a method has been developed for the rapid determination of the coefficients of a particular analytical representation of the admittance matrix $\left\| \, |y(s)| \, \right\|$ of a transistor. Such representation (two zeroes for each admittance and a common pole) can be obtained by developing a small number of measurements with simple calculations and is satisfactory in the particular frequency range of each transistor. Author

N68-22064*# Electro-Mechanical Research, Inc., Princeton, N. J. Photoelectric Div.

IMPROVED STERILIZABLE MULTIPLIER PHOTOTUBES Quarterly Progress Report, Period Ending 29 Feb. 1968

18 Mar. 1968 11 p Prepared for JPL
(Contracts NAS7-100; JPL-951555)
(NASA-CR-94244; QPR-5) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Multiplier phototubes with visible response were developed for use in applications requiring sterilization, primarily for scintillation counting purposes. High sensitivity bialkali photocathodes were studied on conductive substrates, which were used to eliminate problems due to the high resistivity of the photocathodes; although the interaction between the photocathode and the conductive substrate made it difficult to achieve consistently high photocathode sensitivity. A photocathode was also studied that has high sensitivity but does not become resistive after sterilization and does not require a conductive substrate. M.W.R.

N68-22065# General Electric Co., Syracuse, N. Y. Electronics Lab.

P-I-N DIODE CHARACTERIZATION FOR NANOSECOND PULSE CONTROL APPLICATIONS

Fred N. King Nov. 1967 43 p refs
(R67ELS-83)

This report describes an effort to develop a means of characterizing PIN diodes for use in large signal pulse attenuators. It is found that a relatively simple relationship, which was previously developed for small signal applications, is reasonably accurate for large signals provided that the new concept of forward and reverse lifetimes is accepted. A specific attenuator circuit which may be used to provide dynamic control (amplitude modulation) of nanosecond pulses is also presented. Author

N68-22145 British Columbia Univ., Vancouver.

EVAPORATED SILICON THIN-FILM TRANSISTORS

Clement Andre Tewfik Salama (Ph.D. Thesis) 1966 121 p
Available from Natl. Library of Can. at Ottawa: MF$1.50

The method of fabrication, the theory and the properties of evaporated silicon thin-film transistors are discussed. The device consists of a p-type silicon film on a sapphire substrate, with aluminum source-drain electrodes evaporated onto the silicon and followed by a silicon oxide, SiO_x insulating layer and an aluminum gate. The device operates by field-effect conductivity modulation of an n-type inversion layer at the surface of the p-type film. The silicon films were evaporated by electron beam heating in a typical vacuum at a rate of 200–600 Å/min. The films exhibited single crystal diffraction patterns when deposited at a substrate temperature in the range 1050°C to 1100°C. They were found to be high resistivity p-type and the hole mobility was of the order of 20–30 cm^2/volt-sec. The minority carrier lifetime was 1–2 μsec and the optical absorption edge of the films was found to be broader than the absorption edge of single crystal silicon at all substrate temperatures. Dissert. Abstr.

N68-22302*# National Aeronautics and Space Administration, Washington, D. C.

RECENT ADVANCES IN DISPLAY MEDIA

1968 129 p refs Symp. held at Cambridge, Mass., 19–20 Sep. 1967
(NASA-SP-159) GPO: HC$1.00; CFSTI: MF$0.65 CSCL 17G

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N68-22303*# Boeing Co., Seattle, Wash.

COMPUTER-MANAGED DISPLAY SYSTEM FOR ADVANCED COMMERCIAL TRANSPORTS

W. C. Dersch and Robert T. Johnson *In* NASA, Washington Recent Advan. in Display Media 1968 p 1–9 refs (See N68-22302 12-09)

The computer-managed display system is part of an automatic flight management system study designed to evaluate applications for automation in commercial air transport operations. The display system employs cathode ray tubes (CRT's) and appropriate solid-state displays to provide the flight crew with automatically sequenced, time-varying information that is not only more accurate and complete than that provided by conventional flight deck instrumentation, but is more pertinent to each flight regime and requires less manual control and adjustment. The prime purpose of this paper is to stimulate the development of components needed for such display systems. Author

N68-22304*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
DISPLAY REQUIREMENTS FOR ADVANCED MANNED SPACECRAFT
Robert C. Duncan *In its* Recent Advan. in Display Media 1968 p 11–21 (See N68-22302 12-09)

Computer directed displays and controls are a significant man–machine integration factor for advanced manned spacecraft missions. In automatic control systems during Apollo missions, the astronaut will monitor the performance of the vehicle and will take over and control it manually in the event of equipment malfunctions by comparing the performance of redundant systems and by choosing the solution that compares most closely with his own simplified solutions made from charts and nomograms. The Apollo Command and Lunar Modules will use a computer to provide the pilot with trajectory data projected to some future time or future orbit and with emergency maneuver data if required. The computer provides the pilot also with window coordinates of a landing site by displaying this information on a keyboard so that the pilot can visually locate the site on the window. Illustrations for the Mercury, Gemini, and Apollo spacecraft main display consoles are included. G.G.

N68-22306*# Purdue Univ., Lafayette, Ind.
RECENT ADVANCES IN CATHODE-RAY-TUBE DISPLAY DEVICES
Joseph A. Davis *In* NASA, Washington Recent Advan. in Display Media 1968 p 25–39 refs (See N68-22302 12-09)

The present state of the art in cathode-ray-tube (CRT) displays is reviewed, and current research and development in CRT components is described, along with the most recent application of these materials. Future prospects regarding the CRT are discussed. The major points discussed in this paper include the following: methods for generating electrons; developments in luminescent materials; resolution, brightness, and contrast techniques; new display tubes; developments in color CRT technology; developments in bandwidth reduction; and developments in projection display techniques. Author

N68-22307*# Marquardt Corp., Van Nuys, Calif.
CARRIER INJECTION ELECTROLUMINESCENCE
Jacques Hanlet and Ralph W. Haas *In* NASA, Washington Recent Advan. in Display Media 1968 p 41–49 refs (See N68-22302 12-09)

This survey on carrier injection electroluminescence as display medium considers a wide range of materials, display device structures, and the fabrication processes for individual display system requirements. A review of the mechanisms involved in producing electroluminescence by carrier injection and evaluation of the desirable optical properties of materials in relation to the spectral response of the human eye is given. It is shown that the II-VI compounds are most desirable for use as carrier injection host materials. As carrier injection host crystal materials, ZnSe, ZnTe, and CdS most closely match the peak of human visual sensitivity. A heterojunction structure of combined II-VI compounds is found most promising for producing efficient electroluminescence at room temperature. G.G.

N68-22308*# General Precision, Inc., Little Falls, N. J. Aerospace Research Center.
THERMOCHROMIC DISPLAYS
D. Grafstein, R. P. Burkowski, M. Kornblau, and W. L. Flint *In* NASA, Washington Recent Advan. in Display Media 1968 p 53–61 refs (See N68-22302 12-09)
(Contract NAS12-89)

The feasibility of using thermochromic materials in display devices is under investigation with particular emphasis on their use in cathode-ray tubes (CRT's). Reversible color changes have been observed when Ag_2HgI_4 or Cu_2HgI_4 target films were irradiated with electron beams. Likewise, simultaneous thermochromism and cathodoluminescence have been demonstrated for mixtures of Ag_2HgI_4 and conventional CRT phosphors. Some limitations of thermochromics for device use are discussed. Studies directed at improving the existing ternary mercuric iodides, as well as other potential thermochromic materials, are also described. Author

N68-22309*# Corning Glass Works, N. Y. Research and Development Labs.
PROPERTIES AND APPLICATIONS OF PHOTOCHROMIC GLASSES
R. J. Araujo *In* NASA, Washington Recent Advan. in Display Media 1968 p 63–69 refs (See N68-22302 12-09)

The behavior of photochromic glasses results from reaction of light with silver halide crystals deliberately formed in the glass during its manufacture. The mechanism of the photolytic reactions is postulated and compared with the theory of the photographic process for silver halides. Reversibility of photochromism in these glasses is explained by prevention of diffusion of the products of photolysis from the original crystal site within the glass structure and their subsequent recombination when the activating light is removed. These glasses show large ranges in all their photochromic properties resulting from ranges in composition and in size and number of the included crystals. The behavior of typical glasses is reported in this paper, and some applications for these glasses are suggested. Author

N68-22311*# Sinnott Corp., San Mateo, Calif.
MAGNETIC DISPLAY DEVICES
Richard C. Sinnott *In* NASA, Washington Recent Advan. in Display Media 1968 p 81–88 refs (See N68-22302 12-09)

This survey on magnetic display devices considers the various properties and applications of magnetomechanical displays, magneto-optical displays, combinations of magnetic and electrostatic display techniques, and ferromagnetographic devices. Magnetic display devices provide constant contrast, rapid switching, hardcopy capability, high resolution, color capability, bilateral interface, and memory. A combination with solid state devices, bulk processing techniques, and computer displays provides superior electrical readout capabilities in man machine systems. G.G.

N68-22312*# Stanford Research Inst., Menlo Park, Calif.
ELECTROSTATIC DISPLAYS
Philip Rice *In* NASA, Washington Recent Advan. in Display Media 1968 p 89–92 refs (See N68-22302 12-09)

Electrostatic printing uses the tendency of fine particles to collect in areas of high static-charge concentration to obtain a display. Surface charge patterns are formed by direct charge deposition from electrodes on a photoconductive surface and thus produce a hardcopy. A cathode ray tube used as label printer in the process can also record standard television pictures in real time. Variations of this charge deposition technique are used to reproduce color images, for projection television systems, for thermoplastic recordings, or in matrix controlled display systems that utilize hinged plates as mechanical light valves. Deenergized electrostatic displays use colloidally suspended elongated particles that align in the direction of an applied electrical field to obtain a desired light transmission. G.G.

N68-22315*# Huyck Systems Co., Huntington Station, N. Y.
MULTICOLOR ELECTROLUMINESCENT DISPLAYS
Kenneth P. Lally *In* NASA, Washington Recent Advan. in Display Media 1968 p 123–129 refs (See N68-22302 12-09)

We have been able to design electroluminescent (EL) displays capable of generating all three primary colors in a single compact element and mixing them at will to provide seven possible color states. The resulting displays provide notable features not generally available in the past, the most salient of which are: (1) A single EL phosphor system is used throughout, which operates at a constant voltage and frequency. (2) Each display element is capable of intrinsically generating or mixing the color primaries, and producing high color saturation. (3) Intrinsic contrast is higher than conventional EL displays. (4) Element-to-element isolation is higher, yet the percentage of display area that can be illuminated is nearly 100 percent. (5) The unusual optical configuration employed permits a number of additional special effects and design options that normally are unavailable in conventional displays. The theoretical principles governing the design of these multicolor elements are presented, and application to an x–y display structure is discussed. Author

N68-22317*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

DISPLAY MEDIA: SUMMARY, INTERPOLATIONS, AND EXTRAPOLATIONS

George Kovatch and Edwin H. Hilborn *In its* Recent Advan. in Display Media 1968 p 143–146 (See N68-22302 12-09)

Modern aerospace vehicles require computer directed display media to transfer information to the human operator. The use of the same basic display system for a number of functions is achieved by calling information out of the computer memory and thus reduce the need for weight, power, and space inherent in separate display systems. For advanced space missions, displays with a reliability extending to several years will be required and it is also expected that multiformat displays will be necessary in supersonic aircraft. G.G.

N68-22342*# Stanford Research Inst., Menlo Park, Calif.

FEASIBILITY STUDY FOR RELIABLE MAGNETIC CONNECTION SWITCH, PHASE 2 Final Report

E. K. van de Riet Feb. 1968 65 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951232; SRI Proj. 5669)
(NASA-CR-94324) CFSTI: HC $3.00/MF $0.65 CSCL 09A

The device that switches power for redundant units of a spaceborn computer must be extremely reliable. This report describes a magnetic power switch having the fail-safe characteristics that allow power to be disconnected from faulty units when failure occurs in the computer unit or in the power switch itself. Fabrication of a breadboard model of the switch is described, as is the experimental verification of its fail-safe characteristics. Author

N68-22400*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A SPACECRAFT ANALOG-TO-DIGITAL CONVERSION SYSTEM EMPLOYING MOSFETS

Donald C. Lokerson Mar. 1968 30 p refs
(NASA-TM-X-63175; X-711-68-91) CFSTI: HC $3.00/MF $0.65 CSCL 09B

The analog-to-digital conversion system described includes an analog commutator, 5 millisecond gated voltage-to-frequency converter, and storage of the digital output to 0.5% resolution of a 0 to +5 volts input. Because of its ultrahigh input impedances and compactness, the system components could be useful in a broad scope of applications. Author

N68-22574# California Univ., Berkeley. Lawrence Radiation Lab.

RECENT DEVELOPMENTS IN LOW-NOISE PREAMPLIFIERS

Emanuel Elad 27 Dec. 1967 14 p refs Presented at the Intern. Symp. on Nucl. Electron. and Radioprotec., Toulouse, 4–8 Mar. 1968
(Contract W-7405-ENG-48)
(UCRL-18005; CONF-680302-1) CFSTI: HC $3.00/MF $0.65

A novel low-noise preamplifier for use with semiconductor radiation detectors is described. The preamplifier utilizes the low-noise characteristics of a liquid-helium-cooled germanium junction field-effect transistor (JFET). The new germanium device is compared with the currently used silicon JFET's. Pulse generator resolution of the preamplifier for zero external capacitance is 0.28 keV fwhm (Ge) with a slope of 0.018 keV/pF. Typical resolution obtained with silicon and germanium detectors for low-energy X-rays is less than 0.4 keV. Author (NSA)

N68-22630# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Angewandte Kernphysik.

THE LEADING-EDGE METHOD WITH PULSE TRANSFORMERS. LOWERING OF THE RESPONSE THRESHOLD BY A LOW-NOISE-LEVEL FAST PREAMPLIFIER [ZUR LEADING EDGE-METHODE MIT IMPULSTRANSFORMATOREN. ERNIEDRIGUNG DER ANSPRECHSCHWELLE DURCH EINEN RAUSCHARMEN SCHNELLEN VORVERSTAERKER]

W. Michaelis Sep. 1967 11 p refs In GERMAN
(KFK-617)

The introduction of a pulse transformer between a semiconductor counter and a charge-sensitive preamplifier for improvement of the registration of time signals is discussed. The time signals produced with a pulse transformer are described. The development of a low-noise voltage preamplifier for the amplification of fast signals of very low amplitude is described, and the circuit is given. The response threshold for a circuit with and without the preamplifier was determined. The results indicated that the use of the preamplifier increases the sensitivity by a factor of 3. The preamplifier has good linearity. NSA

N68-22732*# Auburn Univ., Ala. Microwave Research Lab.

THE DESIGN OF A SOLID-STATE SINGLE-ENDED SWITCHING DC TO DC CONVERTER

M. A. Honnell and W. W. Agerton [1967] 69 p refs
(Contract NAS8-11184)
(NASA-CR-61737) CFSTI: HC $3.00/MF $0.65 CSCL 09A

This investigation is concerned with the development, design, and construction of a dc to dc converter to provide power for a television transmitter to be used in space vehicles. The converter is implemented with solid-state components and an isolation transformer used in a single-ended switching configuration. The theory and equations describing the operation of the converter are presented. The design equations of the isolation transformer are developed for the ideal case. A single-ended switching dc to dc converter was designed and constructed. The prototype was subjected to electromagnetic compatibility tests and temperature tests. The nominal input and output voltage of the converter is 28 Vdc. The output voltage remained within ±0.325 percent of the nominal output voltage over the complete temperature range, complete load range, and complete input voltage range. The converter has a maximum d-c output impedance of 0.1021 ohms and maintained an overall operating efficiency of approximately 80 percent under all conditions of operation. Author

N68-22926# California Univ., Berkeley. Lawrence Radiation Lab.

PUZZLE: A PROGRAM FOR COMPUTER-AIDED DESIGN OF PRINTED-CIRCUIT ARTWORK

Ronald Zane and Deanna A. Wilber 12 Sep. 1967 5 p Presented at the Intern. Conf. on System Sci., Honolulu, Hawaii, 19–31 Jan. 1968
(Contract W-7405-ENG-48)
(UCRL-17814; CONF-680106-3) CFSTI: HC $3.00/MF $0.65

A program developed to aid in the solution of the topological problems encountered in printed-circuit artwork design is described. It is emphasized that the program is intended as a tool for use by the designer to reduce the human effort required to produce both the topological solution and the graphic output needed for the manufacture of etched printed circuit boards. A method of describing the location of individual pads and a library of modular components is discussed. The program is intended to have maximum use in the area of two-sided printed-circuit boards for integrated circuits. It is also possible to design discrete component circuits with the existing version of the program. Author (NSA)

N68-22999# Commissariat a l'Energie Atomique, Saclay (France).
CONTRIBUTION TO THE STUDY OF THE BEHAVIOR OF SILICON PLANAR TRANSISTORS EXPOSED TO THE ^{60}CO γ RAYS [CONTRIBUTION A L'ETUDE DU COMPORTEMENT DES TRANSISTORS SILICIUM A STRUCTURE PLANE SOUMIS AUX RAYONS γ DU ^{60}CO]
Jacques le Ber (Ph.D. Thesis—Paris Univ., Orsay) Dec. 1967 63 p refs In FRENCH; ENGLISH summary
(CEA-R-3313) CFSTI: HC$3.00/MF$0.65

Studies were carried out on bipolar silicon planar transistors irradiated by ^{60}CO γ rays. The author describes the interactions on the matter of the different types of particles and he gives a brief bibliographical recall of foreign studies. The technological structure of the planar transistors is then described, and general comments are made about the choice of measured parameters and on the statistical interpretation of results. An automatic instrument for the measurement of the gain is described and the reproductibility of the results is stated. The complexity of the problem and the difficulty to predict the behavior of the semiconductors components are clearly shown. The observed dispersions depend on the electrical bias during irradiation, the injection level in the emitter-base junction during the measurement, the manufacturer for a given type, the instantaneous dose rate, and the geometry used. The problem is then examined from the reliability point of view and methods are given to evaluate the reliability for a given dose. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N68-21881# Cornell Univ., Ithaca, N. Y. School of Electrical Engineering.
HIGH FREQUENCY GENERATION AND AMPLIFICATION
31 Aug. 1967 97 p Conf. held 29–31 Aug. 1967
(Grant Nonr(G)-00021-67)
(AD-666582)

The conference on high frequency generation and amplification is the first of a series of biennial conferences on engineering application of electronic phenomena to be offered by the school of electrical engineering, Cornell University. Nearly four hundred participants attended the sessions. Thirty nine scientific papers were presented. These papers encompassed fundamental physics of the Gunn effect, LSA mode, avalanche phenomena, surface recombination effects, acoustoelectric interactions in semi-conductors, and quantum electronics, as well as, the applications of these physical mechanisms in devices such as Read, Gunn, and LSA oscillators. The meetings also included presentations on the interaction of devices with circuits in parametric amplifiers and multipliers, novel forms of integrated microwave circuitry, and new miniaturized radar systems. TAB

N68-21931 Saskatchewan Univ., Saskatoon.
A THREE VARIABLE SELF-ADAPTIVE FLIGHT CONTROL SYSTEM USING DISCRETE INTERVAL BINARY NOISE PERTURBATION SIGNALS
P. N. Nikiforuk and R. J. Pronovost [1968] 10 p refs
CFSTI: $3.00

Performance of a proposed self-adaptive flight control system was evaluated using a digital computer to verify the basic assumptions of the theoretical synthesis, simulate each of the self-adaptive loops, simulating the entire system to include the dynamic and interaction effects. Pseudorandom discrete interval binary noise (DIBN) was found to be an excellent perturbation signal from both theoretical and practical points of view. Errors associated with pseudorandom DIBN, even without compensation, are found to be considerably smaller than those associated with random DIBN. This study was centered on the pitch orientation control system of a high performance vehicle whose aerodynamic gain, damping, and undamped natural frequency vary widely with flight conditions. A three-variable self-adaptive configuration that can automatically and continuously identify the aerodynamic parameters was used. M.W.R.

N68-22015*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.
OPTIMAL CONTROL OF LINEAR STOCHASTIC SYSTEMS WITH MEASUREMENT ERRORS
John J. Deyst, Jr. Feb. 1968 28 p refs
(Grant NGR-22-009-207)
(NASA-CR-94291; RE-40) CFSTI: HC $3.00/MF $0.65 CSCL 09C

A method is presented for determining optimal feedback controls for linear gaussian stochastic systems, when the system state cannot be determined without error and the cost function is nonquadratic. The method is applied to the minimum fuel spacecraft midcourse guidance problem and the form of the optimal feedback control is determined. Author

N68-22032 Rennselaer Polytechnic Inst., Troy, N. Y.
VOLTAGE SURGES INDUCED ON OVERHEAD LINES BY LIGHTNING STROKES
Pritindra Chowdhuri (Ph.D. Thesis) 1966 194 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-4160

The present study is analytic in nature, its purpose being to explore the possibility of predicting the parameters of a lightning stroke such as peak and front time of the return-stroke current etc. from oscillograms of induced voltages; it is also the purpose of this study to be able to estimate the magnitude of the voltage on a power line induced by a nearby stroke of known parameters. The front time and the peak of the return-stroke current can be estimated from the oscillograms of the induced voltages. The magnitude of the induced voltage would generally be higher on a three-phase system than on an equivalent single-conductor line. The peak of the induced voltage can become excessively high if either the front duration of the return-stroke current is very short or if the magnitude of this current is very high. Ground wires do reduce the magnitude of the induced voltage to some extent. This reduction is, however, not enough to preclude the installation of lightning arresters in the low-voltage systems. Dissert. Abstr.

N68-22055 California Univ., Berkeley.
CONTROLLABILITY AND OBSERVABILITY OF LINEAR TIME-INVARIANT COMPOSITE SYSTEMS
Chi-Tsong Chen (Ph.D. Thesis) 1966 78 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-5026

This paper solves completely the (state) controllability and observability of the representations of the parallel, the tandem and the feedback connections of linear, time-invariant finite-dimensional systems. It also solves completely the output controllability of such systems. The output controllability being a system property requires only the knowledge of the transfer function matrices. (State) controllability and observability are properties of the representation. Controllability and observability of the representations of composite systems is considered under the assumption that the Jordan canonical form is available. In our study of tanden connection, the transfer function matrices play an essential role. Dissert. Abstr.

N68-22091 Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands).

THE MEASUREMENT OF CORRELATION FUNCTIONS IN CORRELATORS USING SHIFT-INVARIANT INDEPENDENT FUNCTIONS

J. B. H. Peek 1968 80 p refs

(Rept.-1)

A method is described which transforms a set of analog signals into a set of bivalent signals such that the correlation function of the analog signals is approximated by that of the bivalent signals. This is done in order to obtain the advantages of digital signal processing, particularly stability of the correlator over long integration times, which is essential for the detection of weak signals. This stability is very difficult to obtain with analog equipment. In the digital correlator, shift registers can be used as delay units, multiplication is accomplished by modulo-2 addition, and integration is done by counting pulses. In order to make the transformation, auxiliary functions are added to the analog input signals, after which the sum signals are hard-limited, and the resulting bivalent signals correlated. The auxiliary functions are "shift-invariant independent" deterministic waveforms rather than the sample functions of random processes used in earlier works on this subject. The output SNR of this correlator can be, for Gaussian input signals and certain parameter values within the correlator, less than 1 dB below the SNR of the ideal analog correlator. Author

N68-22103 California Univ., Berkeley.

PERTURBED OPTIMAL CONTROL PROBLEMS

Andrew John Korsak (Ph.D. Thesis) 1966 77 p

Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-5098

Effects of perturbations of an optimal control problem upon its optimal control are studied for (1) fixed-time, fixed-initial-point, free-terminal-point optimal control problems and (2) certain calculus of variations problems interpreted as optimal control problems. An optimal control is found to depend continuously upon the optimal control problem, with respect to certain natural topologies, provided this optimal control is "essentially unique"; and an "essentially unique" optimal control can exist for an optimal control problem in the classes studied. Some auxiliary results in the calculus of variations are derived to obtain the above conclusions for the second class of problems studied. Among these are an implicit function theorem for absolutely continuous functions and the proof of existence of a field of extremals for certain calculus of variations problems. Dissert. Abstr.

N68-22142 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INDUSTRIAL TELEMECHANICS

8 Sep. 1967 30 p refs Transl. into ENGLISH from the Publ. "Promyshlennaya Telemekhanika" Moscow, Izd-Vo Energ., 1966 p 110–118, 165–182 Presented at the Sci.-Technol. Conf. on Means of Ind. Telemech.

(FTD-MT-24-149-67; AD-666153)

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N68-22143 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF REDUNDANCY ON RELIABILITY OF SYSTEMS [VLIYANIYE REZERVIROVANIYA NA NADEZHNOST' SISTEM]

V. V. Naumchenko *In its* Ind. Telemech. 8 Sep. 1967 p 1–7 refs (See N68-22142 12-10)

The problem of system reliability with various degrees of redundancy represented by "cold" or "hot" reserve elements is briefly reviewed. A linear relationship between the average system lifetime and the relative redundancy is established for an ideal case with "cold" or "hot" reserve elements. The required redundancy is about the same for the "cold" and "hot" cases if $m \leq 1$; however, with $m > 1$, the required "hot" redundancy increases rapidly; $T_s = mT_0$, where T_s is the specified lifetime and T_0 is the average lifetime of an element under working conditions. Formulas for reliability and average lifetime are written for a system whose each element has "cold" or "hot" reserve. Mean time to failure of Shannon–Moor Iw-networks is discussed. Author

N68-22144 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SELF-CONTROL, SELF-CORRECTION, AND SELF-REPAIR IN TELEMECHANICAL DEVICES [SAMOKONTROL', SAMOKORREKTSIYA I SAMOREMONT V TELEMEKHANICHESKIKH USTROYSTVAKH]

A. N. Radchenko *In its* Ind. Telemech. 8 Sep. 1967 p 8–22 refs (See N68-22142 12-06)

A telesystem with a single-error-correcting code is used as an example to show that the system reliability is in contradiction with the system error correction. Application of powerful correcting codes is generally regarded as "inexpedient." Steps to enhance reliability of counting circuits, distributors, and decoders are suggested; the results are obtained by "intracircuit coding." Decoding equipment can be simplified by using cyclic codes. A correcting system consisting of delay cells and adders, equipped with a 2-loop feedback, and using Brown code is considered which possesses a "self-control" characteristic, i.e., discontinues its operation when a fault occurs. The self-correction feature is needed only when registers with logic feedback are used as counting devices of certain special characteristics. With systematic malfunctions or upon a single failure, the correcting circuit will perform the functions of the faulty element. Correcting codes permit quick location of the fault. With the expedience of repair determined by some means, self-repair can be achieved by the Steinbuch learning matrix which forms new circuit connections; the possibilities of this method are explored. Author

N68-22234*# Texas Instruments, Inc., Dallas.

PHOTON-COUPLED ISOLATION SWITCH Quarterly Report, 1 Oct.–31 Dec. 1967

E. L. Bonin and E. E. Harp 31 Dec. 1967 18 p refs Prepared for JPL

(Contracts NAS7-100; JPL-951340)

(NASA-CR-94321; Rept.-03-68-25; QR-8) CFSTI: HC $3.00/MF $0.65 CSCL 09A

A new type of integrated circuit switch which uses internal photon generation and detection techniques is being developed. Internal optical coupling is used to allow electrical isolation between the driving source and the output switch terminals. The device, called the photon-coupled isolation switch, consists of a monolithic silicon integrated driver circuit which supplies bias to a gallium arsenide photoemitting diode. The emitting diode is optically coupled to an electrically isolated silicon phototransistor which provides the isolated output switch terminals. During the last quarter, the integrated circuit processing was continued. Good driver circuit wafers were produced. Isolation switches were assembled, tested and found to satisfy the design requirements and device specifications. Author

N68-22285 Joint Publications Research Service, Washington, D. C.

SOME SPECIAL APPLICATIONS OF CYBERNETIC TECHNIQUES

6 May 1968 19 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), no. 5, 1967 p 1030–1035, 1219–1222
(JPRS-45276) CFSTI: $3.00

CONTENTS:

1. THE USE OF CONTROLLED FEEDBACK IN IDENTIFYING AND EVALUATING THE STABILITY STORE OF STOCHASTIC OBJECTS V. V. Belyy and M. F. Dimentberg p 1–6 refs (See N68-22286 12-10)
2. GENERALIZATION OF INAGAKI'S THEOREM I. G. Globenko p 7–10 refs (See N68-22287 12-19)
3. BASAL METABOLISM IN ANIMALS IN CONNECTION WITH THE NEGENTROPY PRINCIPLE OF INFORMATION A. I. Bykhovskiy p 11–17 refs (See N68-22288 12-04)

N68-22286 Joint Publications Research Center, Washington, D. C.

THE USE OF CONTROLLED FEEDBACK IN IDENTIFYING AND EVALUATING THE STABILITY STORE OF STOCHASTIC OBJECTS

V. V. Belyy and M. F. Dimentbert *In its* Some Spec. Appl. of Cybernetic Tech. 6 May 1968 p 1–6 refs (See N68-22285 12-10)

A functioning object with one input and one output is considered that undergoes continuous stationary random variations so that in the aggregate statistical instability results from slight perturbations. The object is connected to controlled feedback to identify and evaluate this instability and to estimate the so-called stability reserve. A solution is evolved for the case of a system with a randomly varying damping factor, and this is considered applicable in cases when the eigenfrequency of the system undergoes sufficiently slow random changes as well as to other situations. M.W.R.

N68-22335 Saskatchewan Univ., Saskatoon.

A THREE-PARAMETER SELF-ADAPTIVE CONTROL SYSTEM EMPLOYING DISCRETE INTERVAL BINARY NOISE PERTURBATION

Raymond Pronovost (Ph.D. Thesis) 1966 288 p
Available from Univ. Microfilms: HC $13.05/MF $3.70 Order No. 67-4787

It was the purpose of this project to investigate the feasibility of a three-variable self-adaptive flight control system which uses correlation techniques for the identification process and discrete interval binary noise for the perturbation signal. In the initial stages of this thesis a three-variable self-adaptive flight control system is theoretically synthesized. The limitations of the self-adaptive flight control system are examined in detail in the second portion of the thesis. The errors which arise as a result of the identification procedures are identified and their effect on the performance of the system is determined. In the final stages of the thesis analogue and digital computer simulation models are developed for the self-adaptive flight control system. The performance of these models is examined. These results are then compared to those obtained theoretically and the performance of the proposed self-adaptive flight control system is judged on this basis. Dissert. Abstr.

N68-22440*# Santa Clara Univ., Calif.

ABSOLUTE STABILITY AND PARAMETER SENSITIVITY

D. Siljak 26 Apr. 1968 11 p refs
(Grant NGR-05-017-010)
(NASA-CR-73218) CFSTI: HC $3.00/MF $0.65 CSCL 09A

This paper extends the notion of absolute stability to include the parameter variations of the linear part of the system. A simple analytic procedure is proposed to calculate the regions of absolute stability in the parameter space. Then, a parallelepiped of maximum volume is imbedded in the region to interpret its boundaries and obtain readily the information about parameter variations which do not affect the system stability. Author

N68-22445# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.

OPTIMIZATION OF CONTROL SYSTEMS BY AN ANALOG METHOD

A. Garroni and A. Lucia 1968 26 p refs
(EUR-3735.e)

A method of optimizing the operation of a plant subject to random disturbances, whose effect can be decreased by means of suitable non-linearities inserted in the feedback chain, is described. The system in question, which is subjected to random stationary perturbations, is optimized under operating conditions, in the steady state, by minimizing a functional consisting of a linear combination of mean quadratic values and mean moduli of a few significant parameters. By using analog techniques to solve the dynamic equations of the system, the perturbations are introduced as perturbing signals; the functional is obtained in terms of the parameters of the nonlinearities. A minimum condition can thus be readily pinpointed. Particular reference is made to nuclear reactors, in which hypotheses and techniques of this type play a particularly important part. Author (NSA)

N68-22622# Union Carbide Nuclear Co., Oak Ridge, Tenn. Gaseous Diffusion Plant.

USER'S MANUAL: UCARDS. UNION CARBIDE AUTOMATIC ROUTING AND DESIGN SYSTEM FOR PRINTED CIRCUIT BOARDS

J. F. Jamison 25 Jan. 1968 91 p
(Contract W-7405-ENG-26)
(K-1736) CFSTI: HC $3.00/MF $0.65

UCARDS is a computer aided design system for producing component layout, conductor layout, and other aids to the fabrication of printed circuit boards. This manual is intended to serve as a guide to the proper use of the system. Author (NSA)

N68-22661# California Univ., Livermore. Lawrence Radiation Lab.

ELECTRONIC CIRCUIT DESIGN USING COMPUTERS

Waldo G. Magnuson, Jr. and Franklin F. Kuo (Hawaii Univ.) Sep. 1967 4 p Presented at the Intern. Conf. on System Sci., Honolulu, Hawaii, 29–31 Jan. 1968
(Contract W-7405-ENG-48)
(UCRL-70706; CONF-680106-2) CFSTI: HC $3.00/MF $0.65

The requirements imposed for the effective use of computer analysis programs in electronic circuit design include a consideration of the design method, the computer system, the engineer-computer interface, and the analysis programs themselves. The above requirements are examined by describing the design loop, by comparing time-sharing with batch processing, by discussing graphical communication with an analysis program, and finally it makes some general comments regarding computer-aided electronic circuit design. With the development of more effective on-line, graphical consoles and the design of network analysis programs tailored for this environment, the computer-aided design loop will be closed and a more effective means of design be realized. Author (NSA)

N68-22758# Joint Publications Research Service, Washington, D. C.

STABILITY OF NONLINEAR PULSE SYSTEMS

A. Kh. Gelig 2 May 1968 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Leningrad), v. 178, no. 4, 1968 p 793–796
(JPRS-45244; UDC-62-50)

A mathematical model is presented for a nonlinear pulse system in which the constants and functions represent natural oscillations of the linear part of the system. Some characteristics of the pulse elements are defined, and three theorems are solved for special cases of the stability of pulse elements in nonlinear pulse systems. M.W.R.

N68-22774*# Connecticut Univ., Storrs. School of Engineering.
LYAPUNOV CONTROL-SYSTEM SYNTHESIS OF A HIGHLY RESONANT PLANT
Donald W. Jorgenson, Jr. and David P. Lindorff Apr. 1968 34 p refs
(Grant NsG-309)
(NASA-CR-94421) CFSTI: HC$3.00/MF$0.65 CSCL 09C

The problem areas and possible solutions which arise when a Liapunov design is applied to a physical system of some complexity is presented. In order to illustrate the principal advantages of Liapunov theory, which is a guarantee of stability within a region of the state space, a plant was selected in which stability problems might occur. The design objective was to control the plant as close to its reasonant frequency as possible, considering the physical limitations of the equipment. The various aspects of the engineering design problem are considered and the experimental method of arriving at a final design which yields a suitable response in the presence of instrument noise is presented. The system states are defined as the error between the states of the model and those of the plant. A Liapunov controller is described which will be derived to control the system, and a model to meet system specifications is developed. B.S.D.

N68-22812* Brown Univ., Providence, R. I. Div. of Applied Mathematics.
NUMERICAL METHODS FOR THE SOLUTION OF THE DEGENERATE NON-LINEAR ELLIPTIC EQUATIONS ARISING IN OPTIMAL STOCHASTIC CONTROL THEORY
Harold J. Kushner and Allan Kleinman [1967] 34 p refs
(Grants NGR-40-003-015; AF-AFOSR-693-67; NSF GK-967)
(NASA-CR-94427) CFSTI: $3.00 CSCL 09C

An iterative method is derived for obtaining the solution of optimal control problems for Markov chains. The method usually converges much faster, and requires less computer storage space, than the methods of Howard or Eaton and Zadeh. Non-linear finite difference equations which 'approximate' the non-linear degenerate elliptic equation (2) arising out of the stochastic optimization problem are found. The difference equations, and their solution, may have a meaning for the control problem even when it cannot be proved that (2) has a solution. The iterative methods for the interative solution of these non-linear systems are discussed and compared. Both converge to the solution (provided that the difference equations were derived using the method introduced in the paper). The method of obtaining the differece equations, and the proof of convergence of the associated iterative procedures, is illustrated by a detailed example. specific numerical results for a 'minimum average time' type of optimization problem are presented and discussed. Author

N68-22906 Thomas Bede Foundation, Los Altos, Calif.
OPTIMIZATION STUDY OF CIRCUIT CARD DESIGN
John Ulrich and Laura Cameron Ulrich Dec. 1967 64 p refs
Prepared for Sandia Corp.
(SC-CR-67-2862) CFSTI: HC$3.00/MF$0.65

An optimization study to continue on the now well defined problem of circuit card etching layout was undertaken as a theoretical study which would be ideally suited for digital (i.e., noninteracting by mutual inductance, etc.) components. It involves a heuristic logic that is valid and optimum for independent components with no lead length problems; but would not be valid for high frequency analog circuits. The study was verified by computer programs. Author

N68-23003# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIGITAL DEVICES FOR AUTOMATIC CONTROL: MEASUREMENT AND GUIDANCE
I. V. Butusov 11 Aug. 1967 387 p refs Transl. into ENGLISH from the publ. "Tsifrovyye Ustroystva Dlya Avtomaticheskogo Kontrolya, Izmereniya i Upravleniya" Leningrad, Izd. Hedra, 1964 p 1-387
(FTD-MT-65-61; AD-666726)

The book considers digital equipment for automatic control and measurement of production processes. It presents the basic characteristics and describes the operating principles of automatic digital instruments, machines for centralized control, and automatic control machines. Basic attention is given to digital equipment using ferrite and semiconductor components. The book is intended for engineers and technicians concerned with the development and use of automation resources; it can also be useful to students in higher educational institutions and technicums specializing in instruments and systems of automatic control. Author (TAB)

N68-23041# Polytechnic Inst. of Brooklyn, N. Y. Electrical Engineering Dept.
REGULAR EXPRESSIONS AND CHECKING EXPERIMENTS
S. Erol Gelenbe Sep. 1967 54 p refs
(Contract AF 49(638)-1402)
(PIBMRI-1378-67; AFOSR-68-0218; AD-666696)

The paper reviews the theory of regular expressions and focuses some attention on their use for the representation of the state behaviour of sequential machines. A brief review of diagnostics making use of distinguishing sequences for the design of text experiments for strongly connected machines follows. These principles are then applied to the systematic design of present checking experiments for which two design methods are proposed. Both these methods involve the solution of n-simultaneous regular equations. An upper bound to the length of the experiments is formulated. The length of the experiments designed in the fashion is seen to be of the same order of magnitude but generally somewhat longer than the length which would be obtained by the other methods on the same principles which have appeared in the literature. Author (TAB)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N68-21874*# National Aeronautics and Space Administration. Manned Spacecraft Center, Langley Station, Va.
CONCEPT, DESIGN, AND PERFORMANCE OF THE MSC SPACECRAFT ACOUSTIC LABORATORY
Robert J. Wren, Wade D. Dorland, James D. Johnston, Jr., and Kenneth Mck. Eldred (Wyle Labs., El Segundo, Calif.) Mar. 1968 5m p refs
(NASA-TM-X-58017) CFSTI: HC$3.00/MF$0.65 CSCL 14B

To ground-test the flight worthiness of the Apollo spacecraft to launch and boost fluctuating pressure environments, a spacecraft acoustic laboratory was designed and constructed. Apollo acoustic levels and spectra were used to develop acoustic test energy requirements and frequency considerations. The test configuration includes 16 horn/duct channels, each driven by an independently controllable acoustic noise source, which completely envelop the vehicle and control the propagation of high-energy acoustic waves downward over the vehicle. Evaluation of the performance characteristics of the facility was oriented toward verification of acoustic test hardware design and, more importantly, toward comparison of Apollo vehicle vibration responses achieved in the ground test with flight measurements. Author

N68-22063*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RUNWAY GROOVING FOR INCREASING TIRE TRACTION: THE CURRENT PROGRAM AND AN ASSESSMENT OF AVAILABLE RESULTS
Walter B. Horne and George W. Brooks [1967] 18 p refs Presented at the 20th Ann. Intern. Air Safety Seminar, Williamsburg, Va., 4–7 Dec. 1967
(NASA-TM-X-61061; L-5972) CFSTI: HC $3.00/MF $0.65 CSCL 01B

Results obtained from limited operational use of grooved airport runways indicate that tire braking and cornering are substantially improved under wet conditions. Studies underway are expected to provide a further evaluation of possible deterioration of grooved surfaces as a result of weathering as well as grooved runway performance under snow and ice conditions. No complaints have been made by aircraft users of grooved runways with respect to either excessive tire thread wear or maintenance difficulties following the changeover to grooving. M.W.R.

N68-22151*# Martin Corp., Denver, Colo.
APOLLO APPLICATIONS PROGRAM CREW MOTION EXPERIMENT PROGRAM DEFINITION AND DESIGN DEVELOPMENT
C. H. Murrish and G. W. Smith [1967] 456 p refs
(Contract NAS1-7276)
(NASA-CR-66599) CFSTI: $3.00 CSCL 22B

Design criteria, based on near-optimum mathematical models, are presented for onboard spacecraft instrumentation capable of measuring and recording astronaut limb motion and astronaut-induced forces and moments affecting spacecraft attitude control. In addition, a strap-down inertial attitude sensing system design for measuring vehicle attitude perturbations resulting from crew motion is described. Evaluation and performance testing data are given for breadboard models of the limb motion sensor, astronaut position and attitude, digital attitude and rate, force measuring, and data (astronaut data aquisition and local telemetry subsystems) systems. Actual laboratory models of the limb motion sensor and force measuring systems were built. A preliminary circuit design is also included to provide an interface between the individual sensors and the Apollo Applications Program data system. E.J.S.

N68-22154# Australian National Univ., Canberra. Dept. of Engineering Physics.
FEATURES OF THE HIGH FIELD MAGNET LABORATORY AT THE AUSTRALIAN NATIONAL UNIVERSITY, CANBERRA
P. O. Carden Jan. 1967 34 p refs
(EP-RR-19) Available from Australian Natl. Univ. Press, P.O. Box 4, Canberra, A.C.T., 2600. Australia: $A1.00

The High Field Magnet Laboratory at Canberra is described. High-field water-cooled electromagnets produce magnetic fields of hundreds of kilogauss, consume megawatts of power and require thousands of gallons of cooling water per minute. Engineering details are given of the pulsed water cooling system, electrical and control systems, and instrumentation. The paper is prefaced by a description of the Canberra homopolar generator used as energy store and power source for the Magnet Laboratory, and by a discussion of the scientific uses of high magnetic fields. Author

N68-22364*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPOSITE ION ACCELERATOR GRIDS
Bruce Banks Washington 1968 24 p refs Presented at the 3d Intern. Conf. on Electron and Ion Beam Sci. and Tech., Electrochem. Soc. of Boston, 6–9 May 1968
(NASA-TM-X-52425) CFSTI: HC $3.00/MF $0.65 CSCL 20G

An ion extraction system for low voltage mercury electron-bombardment thrusters using a glass coating fused to a perforated metal grid is described. A helium diffusion process which eliminates most of the bubbles in the glass coating has been found that greatly increases the effective dielectric strength of the glass and allows acceptable low voltage ion extraction. Grid fabrication techniques and experimental performance results are also discussed. Author

N68-22437# Argonne National Lab., Ill.
FORMATION OF THE MAGNETIC FIELD IN THE CENTRAL REGION OF THE SYNCHROCYCLOTRON TO INCREASE VERTICAL FOCUSING [FORMIROVANIE MAGNITNOGO POLYA V TSENTRAL'NOI OBLASTI SINKHROTSIKLOTRONA S TSEL'YA UVELICHENIYA VERTINKAL'NOI FOKUSIROVKI]
V. I. Danilov, V. B. Mukhina, and A. N. Safonov May 1967 21 p refs Transl. into ENGLISH from Joint Inst. for Nucl. Res., Dubna, USSR, Publ. No. JINR-P9-3181
(ANL-TRANS-m77) CFSTI: HC $3.00/MF $0.65

Some variants are considered on how to improve the vertical focusing of particles by formation of axially symmetrical magnetic fields with a large drop-off in the central region of the synchrocyclotron as well as by creation of an azimuthally varying magnetic field. It is shown that the use of a magnetic field variation near the center to increase the vertical focusing without considerable diminution of the dee aperture is not advisable, since one does not succeed in providing a sufficiently great variation amplitude at small radii. Author (NSA)

N68-22444# Argonne National Lab., Ill.
RESONATOR OF A PROTON MULTIPLE ACCELERATION SYSTEM IN THE JINR SYNCHROPHASOTRON [REZONATOR SISTEMY KRATNOGO USKORENIYA PROTONOV SINKHROFAZOTRONA OIYAI]
V. A. Vagin, V. D. Volodin, A. P. Saenko, I. N. Semenyushkin, and V. L. Stepanyuk Mar. 1967 12 p refs Transl. into ENGLISH from Joint Inst. for Nucl. Res., Dubna, USSR, Publ. No. JINR-P13-3084
(ANL-TRANS-460) CFSTI: HC $3.00/MF $0.65

A design of the multiple acceleration system resonator is chosen. The main parameters are calculated. The methods of depression of a resonance high-frequency division in vacuum 3.10^{-6} mm Hg without magnetic field and in the presence of a scattered magnetic field $H_z \cong 50$ Oe are described. The results of testing this resonator in the JINR synchrophasotron accelerator are described. Author (NSA)

N68-22570# Brookhaven National Lab., Upton, N. Y.
SUPERCONDUCTING FFAG ACCELERATORS
G. Parzen 21 Dec. 1967 6 p
(BNL-12060) CFSTI: HC $3.00/MF $0.65

Some characteristics of the FFAG accelerators which pertain to the possible use of this type of accelerator for current research in high-energy physics are described. These characteristics are the large radial aperture, and multistage FFAG design possibilities. The parameters chosen for obtaining particle energies of 800-GeV with such a multistage FFAG accelerator are presented. The possible problems of the superconducting FFAG accelerator are discussed. Some hand formulas available for estimating the parameters of the FFAG are included in the appendix. NSA

N68-22591*# Farrand Optical Co., Inc., New York.
VIRTUAL IMAGE OUT-THE-WINDOW DISPLAY SYSTEM STUDY. VOLUME 2: APPENDIX

Matthew Baum, Raymond Bull, Joseph La Russa, Lester Mayer, and Martin Shenker Jan. 1966 411 p refs
(Contract NAS9-3678)
(NASA-CR-65303) CFSTI: HC$3.00/MF$0.65 CSCL 14B

This report contains background material for Volume I of the study program. Included are abstracts of reports and documents pertinent to a study of visual simulation techniques and devices; bibliographic references; a summary of replies to a television survey; a summary of replies to a survey of the visual simulation industry; a report on facility visits; and a guide to visual simulator literature. Author

N68-22597# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

FAST FLUX TEST FACILITY OVERALL CONCEPTUAL SYSTEMS DESIGN DESCRIPTION

C. C. Steele 7 Jul. 1967 75 p
(Contract AT(45-1)-1830)
(BNWL-500) CFSTI: HC$3.00/MF$0.65

The description of the first overall systems design for the FFTF is given. General discussions are given on: utility systems, reactor systems, irradiation test systems and facilities, component handling systems, examination systems and facilities, and unified instrument and control systems. Design requirements for the FFTF are delineated. The safety philosophy behind the systems designs is outlined. Detailed descriptions of the systems are given. NSA

N68-22637# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

SYNCHROTRON FREQUENCY AND STABILITY LIMITS IN THE ELECTRON SYNCHROTRON AS A FUNCTION OF THE NUMBER OF ACCELERATION UNITS [SYNCHROTRONFREQUENZ UND STABILITAETSGRENZE IM ELEKTRONENSYNCHROTRON IN ABHAENGIGKEIT VON DER ZAHL DER BESCHLEUNIGUNGEINHEITEN]

A. Piwinski Nov. 1967 11 p refs In GERMAN; ENGLISH summary
(DESY-67/39)

In very high energy electron synchrotrons or storage rings, the synchrotron frequency may well be of the same order as the revolution frequency. In such cases, a calculation of synchrotron frequency must take into account the subdivision into sections with acceleration and synchrotron radiation, respectively. Performing this calculation by solving for the eigen frequency of the transfer matrix, a more correct value for the synchrotron frequency and also a limit for the stability of the synchrotron oscillation is obtained. Author (NSA)

N68-22668# United Kingdom Atomic Energy Authority, Culham (England).

STOCHASTIC DESTRUCTION OF STELLARATOR MAGNETIC SURFACES [STOKHASTICHESKOE RAZRUSHENIE MAGNITNYKH POVERKHNOSTEI STELLARATORA]

B. V. Chirikov 1966 23 p refs Transl. into ENGLISH from Russian
(Rept.-33, NP-16634; NP-TR-1596)

Some estimates about the stability of the lines of force for a stellarator magnetic field against static perturbations are given. It is shown that increasing of the derivative $d\omega/dz$ (ω is mean rotation speed of the magnetic line at distance z from stellarator's axis around the axis) results in increasing of line stability against resonance perturbations only up to a certain limit. Above that a new so-called stochastic instability may occur. Stochastic instability can be used to realize the so-called Scornyakov's trap which has inside a certain "turbulent" (in respect to "motion" of the magnetic lines) or stochastic region surrounded by "laminar" layer of "proper" magnetic surfaces. Such a structure can be achieved by additional resonance helical winding which period is equal to the revolution period of the magnetic line in the stochastic region. One may expect the suppression of plasma instabilities in the stochastic region by means of additional damping due to the "diffusion" of magnetic lines. Author (NSA)

N68-22684# Commissariat a l'Energie Atomique, Saclay (France).

CELL FOR STUDYING ELECTRON-ADSORBED GAS INTERACTIONS [CELLULE D'ETUDES DES INTERACTIONS ELECTRON-GAZ ADSORBE]

Hanna Golowacz and Denis A. Degras Dec. 1967 15 p refs In FRENCH
(CEA-R-3402) CFSTI: HC$3.00/MF$0.65

The geometry and the technology of a cell used for investigations on electron-adsorbed gas interactions are described. The resonance frequencies of the surface ions which are created by the electron impact on the adsorbed gas are predicted by simplified calculations. The experimental data relative to carbon monoxide and neon are in good agreement with these predictions. Author

N68-22721# Commissariat a l'Energie Atomique, Cadarache (France).

COMPRESSION SYSTEM FOR ION-BURSTS IN THE VAN DE GRAFF AT THE CADARACHE CENTER [SYSTEME DE COMPRESSION DE BOUFFEES D IONS POUR LE VAN DE GRAAFF DU CEN/CADARACHE]

Lucien Rizzitelli, Jean-Claude Carossi, Alain Calvet, Andre Arnaud, and Etienne Pomelas Dec. 1967 31 p refs In FRENCH
(CEA-R-3325) CFSTI: $3.00

This equipment has been designed for the 5 MeV Van der Graff and makes it possible to carry out time-of-flight spectrometry experiments. A pulsed source produces ion-bursts of controllable width between 10 and 50 msec. at a pulse repetition frequency of 3.5 MHz; in each burst the ions are made to follow variable paths so that the particles arrive simultaneously at a pre-selected point. This is achieved by means of a magnet which curves the paths, and at the entrance to which each burst is deflected by two plates which are fed in phase opposition at 7 MHz. Author

N68-22726# Instituto de Investigacion Aeronautica y Espacial, Buenos Aires (Argentina).

RADIATION AND HIGH ALTITUDE LABORATORY

May 1967 50 p refs
(NP-17106)

A brief review is presented of the program of the Laboratorio de Radiaciones y Alta Atmosfera for basic research on low-energy nuclear physics and its application to studies in the upper atmosphere with space vehicles. The investigations of nuclear events in the upper atmosphere are carried out by means of payloads located in rockets produced at the Institute. Some of the studies briefly reported are: orbital-electron capture; internal bremsstrahlung; internal conversion; and X-ray spectroscopy in the upper atmosphere. NSA

N68-22735# Brookhaven National Lab., Upton, N. Y.

TELEMANIPULATION IN A BIG ACCELERATOR

Wolfgang Richter, Melvin Ellefsplass, and Roger Alan Horne 1967 18 p refs Transl. into ENGLISH from Ind. Atomiques (Paris), v. 11, n. 1/2–3/4, 1967 p 77–85
(BNL-TR-180) CFSTI: HC$3.00/MF$0.65

The possibilities of maintenance and repairs to equipment in hot (radioactive) zones in the ring of the CERN proton synchrotron by remote handling are described. NSA

N68-22737*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

VIEWING DEVICES FOR OBSERVING FLOW CONDITIONS IN HOT MERCURY SYSTEMS

Lawrence A. Mueller and David W. Medwid Washington May 1968 22 p refs
(NASA-TM-X-1578) CFSTI: HC$3.00/MF$0.65 CSCL 14B

Windows for both a mercury condensing tube and a mercury-boiler-outlet tube were investigated. A key factor in window design was proper matching of the thermal expansion coefficients of the window, the window sealants, and the window-support structure. The window for the mercury-condensing tube was tested with flowing condensing mercury at 670°F (628°K) and 15 psia (10^5 N/m^2). At room temperature, the window was also subjected to 20-g random vibration. The boiler window was heated in a furnace to 1350°F (1005°K) with gas pressurization of 350 psig (2.4×10^6 N/m^2). Author

N68-22775*# Avco Corp., Lowell, Mass.

STERILIZATION ASSEMBLY DEVELOPMENT LABORATORY, 3000 CU. FT. DECONTAMINATION CHAMBER. PHYSICAL PARAMETERS: MEASUREMENT PLAN, TASK 1.0

E. D. Lantis 15 Aug. 1967 13 p Prepared for JPL
(Contracts NAS7-100; JPL-951624)
(NASA-CR-94392; AVSSD-0300-67-CR) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Test procedure is outlined for establishing uniform physical parameters throughout the 3000 cu ft ethylene oxide (ETO) decontamination chamber over a 24-hr cycle of continuous operation. Ethylene oxide concentration, humidity, temperature, and time are the parameters considered; and equipment required to measure these parameters are listed. Quality assurance provisions are outlined, procedures for preparing for testing are given, and the 24-hr uniform distribution qualification test sequence is outlined. M.W.R.

N68-22776*# AVCO Corp., Lowell, Mass. Sterilization Assembly Development Lab.

A STUDY OF THE EFFECTS OF VARYING THE ESTABLISHED OPERATING AND MAINTENANCE PROCEDURES OF THE EASL FACILITY

E. M. Hajema 15 Aug. 1967 38 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951624, Phase 2)
(NASA-CR-94385) CFSTI: HC$3.00/MF$0.65 CSCL 14B

Microbial burden was increased during assemblies in which the laminar air flow in the Experimental Assembly and Sterilization Laboratory (EASL) was stopped, although other variations from normal laboratory environmental conditions did not significantly increase microbial burden. During normal operations of the facility temperature ranged from 69° to 70°F and humidity from 43 to 47%; and variations studied were (1) 83°F and standard humidity of 45%, (2) 83°F and low humidity between 20 and 25%, and (3) standard temperature and humidity with air blowers off. It was concluded that violations of the clothing requirements by personnel may also result in increased burden on piece parts. Reynier air samples, stainless steel fallout strips, and Rodac impression plates were used for the monitoring. Tables detail results of viable particle counts; and appendices include parts lists, assembly and disassembly operation sequences, and details of the statistical analysis of data obtained with the Reynier air sampler. M.W.R.

N68-22888*# Vitro Labs., West Orange, N. J.

DEVELOPMENT OF A 50 KW FLUID TRANSPIRATION ARC SOLAR SIMULATOR Final Report

D. R. Simon Nov. 1967 46 p refs
(Contract NAS9-5726)
(NASA-CR-92067; VL-2438-14-O) CFSTI: HC $3.00/MF $0.65 CSCL 14B

An engineering model and a complete supporting system including controls and interlocks, water cooling apparatus, a high voltage striker, a gas recirculator, and a gas purifier were designed and built. A quartz dome to enclose the arc head was developed and tested. One test of the redesigned arc head, which was scaled up from a 25 kW unit with a 50 hour lifetime, demonstrated a lifetime of 107 hours in continuous operation at an input level of 40 to 45 kW. No adjustment or maintenance was required during that run and the arc stability was excellent. Measurements of radiant output indicate a source size of approximately 1 cm diameter at 42 kW with an output of 1.34 kW/steradian at 100 psi in argon. Several subsequent tests were made with the arc operating inside a close fitting quartz dome; the useful life of the arc was shortened during these tests due to a greatly increased rate of electrode erosion. Deposition of electrode material on the quartz dome reduced the light output severely in a few hours of operation at 40 kW input. A design is proposed for enclosing both the collecting optics and the arc head assembly in a pressurized tank thus avoiding the need for a close fitting dome on the arc head itself. Author

N68-22946# Commissariat a l'Energie Atomique, Tunis (Tunisia).

REPORT ON ACTIVITIES, 1966–1967 [RAPPORT D'ACTIVITES, 1966–1967]

1967 94 p In FRENCH
(NP-17229)

The general structure of the Tunisian CEA is outlined, and the formation of a documentation center is reported. Studies made with a 14-MeV, neutron generator, desalination of water, prospecting for uranium ores, use of radioisotopes, radiation protection and control, nuclear electronics, and solar energy are briefly summarized. The cooperation with national and international organizations is described. NSA

N68-22951# Princeton Univ., N. J. Plasma Physics Lab.

DIVERTOR OF THE SIRIUS STELLARATOR

O. V. Biryukov, A. V. Georgievskii, V. E. Ziser, B. U. Kravchin, L. Kh. Kitaevskii et al Dec. 1967 34 p refs Transl. into ENGLISH from Russian
(Contract AT(30-1)-1238)
(MATT-Trans-46) CFSTI: HC$3.00/MF$0.65

The basic parameters and structural features of the divertor of the Sirius stellarator are presented. Investigation of the topology of the magnetic field of the divertor by the electron beam method has revealed good comparison between the calculated and experimental results. It is proposed that plasma be injected into a closed magnetic system through a divertor. Author (NSA)

N68-22988# Commissariat a l'Energie Atomique, Saclay (France).

PAGURE ^{60}Co PANORAMIC IRRADIATION FACILITY [PAGURE IRRADIATEUR PANORAMIQUE A ^{60}Co]

Jean Rene Puig, Jaques Laizier, Marcel Lorin, and Roger Laroche Nov. 1967 47 p In FRENCH; ENGLISH summary
(CEA-R-3302) CFSTI: HC$3.00/MF$0.65

A detailed description is presented on the Pagure Co^{60} panoramic irradiation facility, and operational data are provided based on experiences over a five-year period. From the viewpoint of standardization of irradiation facilities, the Pagure is considered a standard design. Author

N68-23010# California Univ., Livermore. Lawrence Radiation Lab.

DESIGN OF THE ASTRON LINEAR ACCELERATOR

J. W. Beal 17 Jan. 1968 15 p refs
(Contract W-7405-ENG-48)
(UCID-15279) CFSTI: HC$3.00/MF$0.65

The design features of a linear induction electron accelerator are described. This accelerator is for use in experiments with the Astron experiment. The parameters of the accelerator are: beam energy 4.23 MeV, beam current 1000 amperes, beam pulse length 0.3 μsec. The design beam emittance is 10π mr–cm in both transverse dimensions and an energy spread of 2 percent fullwidth-half maximum. The accelerator consists of an increasing gradient gun with an output beam energy of 562 keV, followed by two constant gradient injector sections each adding 220 keV to the beam energy. The remainder of the accelerator is made up of seventeen identical accelerator sections each supplying 190 keV to the beam energy. Solenoidal focusing magnets are positioned with a particular magnetic field strength in order to provide phase-space matching between the various sections of the accelerator. Steering magnets are placed so as to compensate for the earth ambient magnetic field and possible stray fields. Author (NSA)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N68-21867*# TRW Systems Group, Redondo Beach, Calif.
AXISYMMETRIC TWO-PHASE REACTING GAS NONEQUILIBRIUM NOZZLE FLOWS ANALYSIS
Victor Quan and James R. Kliegel 18 Aug. 1967 33 p refs
(Contract NAS9-4358)
(NASA-CR-92058; TRW-02874-6007-R000) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Condideration is given to the development of an additional computer program to calculate the performance of propellant systems in axisymmetric nozzles accounting for the nonequilibrium finite rate chemical reactions between gaseous combustion products and velocity and thermal lags between gaseous and condensed combustion products. Equations are derived which govern the inviscid axisymmetric flow of a two-phase reacting gas mixture in the form in which they are integrated in the computer program, and the method used to calculate the transonic initial line is described. Also included are the integration methods employed to calculate the fluid dynamic variables, chemical species, and particle properties. The development of a computer program based on the present analysis is discussed in relation to three parts: a one-dimensional two-phase reacting gas part, an axisymmetric two-phase transonic part, and an axisymmetric two-phase characteristics part. B.S.D.

N68-21905 Michigan Univ., Ann Arbor.
A STATISTICAL STUDY OF LOCAL WALL PRESSURE FLUCTUATIONS IN GAS FLUIDIZED COLUMNS
Frederic Melvin Swinehart (Ph.D. Thesis) 1966 170 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-1814

The intent of this research is the exploration of certain statistical problems which appear as one attempts to extend the existing analytical theory of isolated single bubble behavior in gas fluidized beds to the description of the dense bubble population ordinarily found in such operations. In particular, a method of studying such behavior appropriate to use in an industrial environment was considered important. To demonstrate the utility of the approach, the application of these measurements to a problem in process simulation was included. Dissert. Abstr.

N68-21932 Adviesbureau der Genie, The Hague (Netherlands).
NUMERICAL CALCULATION TO SOME SPECULATION ABOUT AXIALLY SYMMETRICAL POTENTIAL FLOWS
C. Flokstra Jan. 1968 13 p
(Rept.-181; TDCK-50185)

The mathematical model used in developing an ALGOL computer program for calculating stream functions of axially symmetric oil infiltration in a three dimensional space is discussed. A two dimensional coordinate system is used to describe the model in which the two axes are respectively perpendicular to and parallel to the gravity. It is assumed that the depth of the infiltration point below the ground level is such that the infiltrating oil does not reach the surface. The infiltration point is simulated by a point source with a constant source strength, the gravity is simulated by a source at infinity, and the constant groundwater level is brought into the model by introduction of point sources with such a source strength that one axis is the axis of symmetry. Sample input data are given, along with subroutine flow charts and the program listing. E.J.S.

N68-21996# RAND Corp., Santa Monica, Calif.
EXACT SIMILAR SOLUTIONS OF THE LAMINAR BOUNDARY-LAYER EQUATIONS
C. Forbes Dewey, Jr. and Joseph F. Gross Jul. 1967 167 p refs
(Contract DAHC15-67-C-0141; ARPA Order 189-1)
(RM-5089-ARPA; AD-665969)

Tables are given of 1400 values that may be used to determine skin friction, heat transfer, and appropriate boundary-layer thickness parameters for reentry vehicles. Assuming a perfect homogeneous gas atmosphere, the values were computed to an accuracy of four significant figures in terms of eight parameters: positive pressure gradient, Mach number, temperature-viscosity law, leading-edge sweep, wall temperature, Prandtl number, local streamwise velocity, and mass transfer at the surface (positive only). The accuracy requirements were relaxed for very high accelerations. More than five-sixths of the values are presented for the first time; the rest were recomputed to the accuracy of the present program. A key to the tables displays graphically the solutions available. Numerical procedures are given in detail. For application to cases in which not all of the eight parameters are similar, the direct effects of the nonsimilar terms may be calculated by asymptotically expanding the full boundary-layer equations in terms of the departures from similarity. Author (TAB)

N68-22043 Tulane Univ., New Orleans, La.
NUMERICAL SOLUTION OF TRANSIENT COMPRESSIBLE FLOW DISCHARGING FROM A PIPE
David Louis Beauchamp, Jr. (Ph.D. Thesis) 1966 134 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-3827

The hyperbolic system of equations that describe a pipe with one end closed and the opposite end opened for the discharge of a compressible fluid into an infinite reservoir are derived and solved. Two methods are employed to obtain the solutions to the differential equations. An interpolative, first order difference approximation yields solutions for the method of characteristics technique. However, more efficient and accurate techniques result from a bi-tridiagonal algorithm application to the matrix of second-order-correct centered difference equations. Dissert. Abstr.

N68-22079 Texas A&M Univ., College Station.
THE EFFECT OF INTERSTRATA FLOW ON SECONDARY RECOVERY OPERATIONS
William James McGuire 1966 97 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-4710

Compared are the results of studies of stratified linear flow models and a simple mathematical model of the system which separates the flow into linear and rotational components. Fair agreement between the two indicates that the mathematical model may be a useful tool in predicting the results of field operations involving fluid displacement from stratified reservoirs. Also described is a novel potentiometric model of the system involving the use of a conjugate fluid system to obtain differences in conductivity without the diffusion which ordinarily accompanies concentration gradients. The results from studies with this model were used to facilitate the description of the flow for application in the mathematical model. The rapid dissipation of the flood front under conditions of favorable mobility ratio is analyzed. Many of the results of this work are at variance with previous investigations. The only other work involving the use of flow models reported much less crossflow at unfavorable mobility ratios, no effect of stratum width ratio, and failed to observe the pronounced dissipation of the flood front. Dissert. Abstr.

N68-22087*# Tracor, Inc., Rockville, Md.

AN ANALYTICAL STUDY OF THE MEASURED WALL PRESSURE FIELD UNDER SUPERSONIC TURBULENT BOUNDARY LAYERS

Thomas J. Black Washington NASA Apr. 1968 167 p refs
(Contract NAS1-6952)
(NASA-CR-888; TRACOR-RL/67-070-U) CFSTI: HC $3.00/MF $0.65 CSCL 20D

This report presents the results of a short analytical study of the turbulent wall pressure field under supersonic shear layers. The study is based on a theory of wall turbulence which asserts that the turbulent transfer of mass, heat, momentum and energy within the boundary layer are essentially effected within discrete, horseshoe-vortex structures which are generated and maintained by powerful, localized non-linear instabilities within the sublayer and which move downstream over the wall in a characteristic, quasi-frozen, spatial array. In particular, the theory explains the generation of turbulent shear stress in terms of the dynamic interaction between these vortex systems and the basic shear flow through which they move. On the basis of this theory, new scaling laws are proposed for the turbulent wall pressure field under subsonic and supersonic layers. These laws feature quite different scaling parameters for the high and low frequency portions of the spectra and indicate the effect of pressure gradient on the spectra. Author

N68-22097*# Louisiana State Univ., New Orleans.

FLOW LOSSES IN FLEXIBLE HOSE, VOLUME 1 Final Report

Kenneth L. Riley and John R. Langley Sep. 1966 79 p refs
(Contract NAS9-4630)
(NASA-CR-62061) CFSTI: HC $3.00/MF $0.65 CSCL 20D

An empirical method is presented for predicting flow losses and the pressure drop that will result from the flow of any gas or Newtonian liquid through a flexible hose of known dimensions. Water and gas were used as the test mediums. Consideration was given to the effects of straight sections and bending, types of materials and convolutions, convolutions/unit length, convolution height, diameter, bend angle, bend radius, bend radius to diameter ratio, effective roughness factor, effective roughness to diameter ratio, and Reynolds number and friction factor. Correlations relating friction factor and Reynolds number were derived which gave satisfactory agreement between the measured and predicted values. M.G.J.

N68-22098 California Inst. of Tech., Pasadena.

A SINGULAR PERTURBATION METHOD FOR NON-LINEAR WATER WAVES PAST AN OBSTACLE

Peter Paul Augustine Rispin (Ph.D. Thesis) 1967 65 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-3121

The method of matched singular perturbation expansions is used to solve the problem of a steady two-dimensional flow of a perfect fluid with a free surface under the influence of gravity. A flat plate of length l is inclined at an angle α to the horizontal and its trailing edge is immersed to a depth h below the surface of an otherwise uniform stream of infinite depth, the velocity at upstream infinity being U. A parameter $\beta = gl/U^2$ (Froude number $F = \beta^{-1/2}$) is assumed small so that the flow separates smoothly at the leading and trailing edges, giving rise to an upward jet and gravity waves in the downstream. An inner solution for the velocity field is obtained which is valid near the plate and an outer solution which holds far away. These are determined through the orders 1, $\beta\log\beta$, β, $\beta^2\log^2\beta$, $\beta^2\log\beta$ up to order β^2, and are matched with one another to these orders. In contrast with linearized planing theory, the depth of submergence can be prescribed as a parameter. Dissert. Abstr.

N68-22124# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.

JET AND WAKES IN TAILORED PRESSURE GRADIENT

I. Wygnanski and H. E. Fiedler Feb. 1968 39 p refs
(D1-82-0711; Rept.-130)

Similarity solutions of the boundary layer equations representing the flow of jets in an external stream and tailored pressure gradients were obtained. These solutions apply to jets in co-flowing and counter-flowing streams. A number of analytical solutions not previously published were obtained. Of particular interest are the solutions for small increment jets which imply that a Gaussian velocity profile exists far downstream from the origin of the jet, even in arbitrary pressure gradient. The solutions were extended to turbulent flow using the hypothesis of a constant eddy viscosity, which, in turn, was modified to account for intermittency. The theoretical predictions were compared with the measurements of Gartshore in self-preserving wakes and the agreement between theory and experiment is good. Author

N68-22126# National Physical Lab., Teddington (England). Aerodynamics Div.

NEGATIVE ENTRAINMENT IN TURBULENT SHEAR FLOW

P. Bradshaw 16 Oct. 1967 13 p refs
(NPL-AERO-1249, ARC-29546) CFSTI: HC $3.00/MF $0.65

It is shown that entrainment rates can be zero (as in the boundary layer between converging planes) or negative, at any Reynolds number and without any special behavior of the turbulence. Author (ESRO)

N68-22132 Northwestern Univ., Evanston, Ill.

LIGHT EMISSION FROM HYDRODYNAMIC CAVITATION

Frank Bernard Peterson (Ph.D. Thesis) 1966 181 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-4257

The basic phenomenon of cavitation is described and the literature on light emission from ultrasonic and hydrodynamic cavitation is reviewed. Experiments are described in which the characteristics of light emission from hydrodynamic cavitation in a venturi are measured. The shape and intensity of an individual pulse was determined using electronic and photographic summing techniques. Time integrated light intensity measurements were made for the total radiation and for the output of a spectrophotometer. Data were obtained for various quantities of xenon, oxygen, and nitrogen dissolved in water circulated in a closed loop system. It is concluded that the type of gas dissolved in the water significantly effects the light pulse intensity but produces only small changes in the light pulse shape. No correlation appears to exist between the time integrated spectral distribution of the cavitation light and black-body radiation source. Dissert. Abstr.

N68-22133 Stanford Univ., Calif.

AN EXPERIMENTAL STUDY OF TURBULENT BOUNDARY LAYER ON ROUGH WALLS

Chang-Kang Liu (Ph.D. Thesis) 1966 187 p
Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-4395

Experimental data are presented on flow structure, mean, and fluctuating velocities in turbulent boundary layers over a family of flat surfaces with transverse roughness elements made of square bars of variable spacing. All flows were incompressible and had zero streamwise pressure gradient. The flow structures are described for surfaces extending from hydraulically smooth to fully rough. Mean-velocity profiles indicate that a minimum length of rough surface is required to establish agreement with the defect law. The most obvious effect of an increase in surface roughness is the distinct increase of turbulence production and the concomitant increase in the value of eddy viscosity. A universal Gaussian distribution of turbulent intermittency is shown to apply to all available data for flat plate flow when consistent normalizations of the data are employed. An apparently universal correlation for turbulent intensity near the wall is also given. Dissert. Abstr.

N68-22148 Connecticut Univ., Storrs.

THE EFFECT OF LIQUID LAYER PROPERTIES ON SHEAR STRESS IN CONDENSING FLOW IN A HORIZONTAL TUBE

Fred Lee Robson (Ph.D. Thesis) 1966 125 p

Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-4858

Peripheral distribution of liquid during the condensation of steam in a one-inch I.D. tube and wave heights and velocities were measured to determine the geometry of the liquid layer during the condensation of high velocity steam. Of gravity, inertia, viscous and surface forces, those of gravity and inertia were of the greatest importance. At all but the highest qualities, the liquid flowed in a 'stratified-annular' manner; the major portion of the liquid was in a layer along the bottom of the tube with a thin film of liquid on the tube sides and top. The flow became essentially annular at velocity ratios of 100 to 1 or greater. Wave crest to wave average height ratio was independent of the peripheral position and was nearly constant. A method was devised that allowed the wave crest height to be predicted from a knowledge of only the initial conditions and the heat transfer rate. Dissert. Abstr.

N68-22149# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

EFFECT OF AN EXTERNAL VORTEX ON THE BOUNDARY-LAYER AT AN AXISYMMETRIC STAGNATION POINT [EFFET E'UN TOURBILLON EXTERIEUR SUR LA COUCHE LIMITE EN UN POINT D'ARRET DE REVOLUTION]

Gunter Kretzschmar 1967 24 p refs In FRENCH; ENGLISH summary Presented at the AGARD Meeting on Numerical Methods for Viscous Flows, Teddington, Gt. Brit., 18-21 Sep. 1967 Submitted for publication

(ONERA-TP-507) CFSTI: HC $3.00/MF $0.65

The boundary-layer equations are solved at an axisymmetric stagnation point, taking account of the effect of displacement and of a vortex in the external flow. The formulation of the problem consists in collecting the first and second order equations into a single system in which a parameter appears representing the combined effects of displacement and of the vortex. A rheoelectrical technique is used for solving the problem. Results obtained for a large range of conditions of wall temperature and vortex intensity are presented. Author (ESRO)

N68-22165# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

FUNDAMENTAL EXPERIMENTAL RESEARCH ON SEPARATED FLOWS AND SOME APPLICATIONS THEREOF [RECHERCHES EXPERIMENTALES FONDAMENTALES SUR LES ECOULEMENTS SEPARES ET APPLICATIONS]

Maurice Sirieix, Jean Delery, and Jean Mirande 1967 28 p refs In FRENCH Presented at 8th Polish Symp. on Fluid Dyn., Tarda, Poland, 18-23 Sep. 1967 Submitted for publication

(ONERA-TP-520) CFSTI: HC $3.00/MF $0.65

A theoretical method for the study of turbulent settling based on an angular setting law is reviewed; and a settling criterion is proposed for calculating this law. This permits consideration of the effects of the nonuniformity of the aerodynamic flow field, as well as the geometric factors of settling in plane and revolving flow. Initial boundary layer effects, which can be determined by the angular law, were calculated. Some applications and calculations are included for wind tunnel studies. Transl. by M.W.R.

N68-22169 Northwestern Univ., Evanston, Ill.

APPROXIMATION TECHNIQUES IN KINETIC THEORY

Nandlal Jhunjhunwala (Ph.D. Thesis) 1966 108 p

Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-4236

An attempt has been made to apply various techniques for solving the problem of plane, steady, Couette flow using Krook's model. It is found that the CEB technique can be consistently applied at the various levels and yields plausible results. In contrast, Grad's technique does not lead to any meaningful results. Among other techniques, an iterative solution of the equations of the Half-range Polynomial method leads to unsatisfactory results. Also, an integral method, while satisfactory at the first approximation, exhibits some terms at the second approximation not found in the CEB approach. It is demonstrated that the microscopic boundary conditions obtained from the truncated distribution function, both at the thirteen- and twenty-moment level, are inconsistent. The evolution in time of a two-component Maxwell gas using Mintzer's Generalized Orthogonal Polynomial Method is investigated. The two components are assumed to be at different temperatures initially and distributed uniformly in space. The solution obtained exhibits some similarity to the one-component case. This is pointed out and some salient features are noted. Dissert. Abstr.

N68-22184 Maryland Univ., College Park.

ON THE THEORY OF TRANSPORT COEFFICIENTS FOR MODERATELY DENSE GASES

Larry Kent Haines (Ph.D. Thesis) 1966 122 p

Available from Univ. Microfilms: HC $10.15/MF $3.00 Order No. 67-6118

A complete description of the method of Cohen-Dorfman-Ernst (in time or t language) and the method of Zwanzig (in Laplace transform or ϵ language) for computing a density expansion of the diffusion coefficient in a moderately dense gas, with short-range, repulsive molecular interactions, from time-correlation functions is given. Both of these methods are reformulated in order to facilitate their comparison. The methods are found to give identical results for the density expansion of the diffusion coefficient insofar as this expansion exists. It is shown, however, that the methods are not identical for arbitrary t and ϵ; that is, the Zwanzig method is not simply the Laplace transform of the Cohen-Dorfman-Ernst (CDE) method. A derivation of the Zwanzig method is given, and the differences in motivation of the two methods are discussed. Dissert. Abstr.

N68-22200*# United Aircraft Corp., East Hartford, Conn.

EXPERIMENTAL INVESTIGATION OF CONTAINMENT IN CONSTANT-TEMPERATURE RADIAL-INFLOW VORTEXES

John S. Kendall Washington NASA May 1968 49 p refs

(Contract NASw-847)

(NASA-CR-1029; F-910091-15) CFSTI: HC $3.00/MF $0.65 CSCL 20D

An experimental investigation was conducted to determine the containment characteristics of radial-inflow vortexes for potential application to a vortex-stabilized nuclear light bulb engine. Tests were conducted using 10-in.-dia by 30-in.-long vortex tubes. Air used to simulate the buffer gas was injected through ports in the peripheral walls of the vortex tubes. Iodine mixed with one of four other gases (helium, nitrogen, sulfur hexafluoride or a heavy fluorocarbon, FC-77) was used to simulate the gaseous nuclear fuel. The amount and radial distribution of simulated fuel contained in the vortex were determined using an axial light beam absorption technique. The effects on containment of changes in the following were investigated: (1) the geometry of the simulated-fuel injection configurations, (2) the number of thru-flow ports used, (3) the radial Reynolds number (a measure of the amount of flow withdrawn through the thru-flow ports) and the corresponding amount of bypass flow, and (4) the molecular weight of the simulated fuel. Author

N68-22222 Saskatchewan Univ., Saskatoon.
THE SUBMERGED CYLINDRICAL SURFACE JET
Prith Pal Singh (Ph.D. Thesis) 1966 148 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-4788

A submerged, incompressible, steady, turbulent jet issuing from an annular orifice and flowing axially along the outside surface of a cylinder is studied. The effect of the ratio of the cylinder diameter to the annulus width on flow characteristics is presented both as analysed theoretically and measured experimentally. In addition, experimental results are presented for the local Stanton number variation with distance downstream. An "integral analysis" of the flow equations is made by dividing the boundary-layer at its point of maximum velocity into two separate similar regions. The experimental test results are presented for flows along cylinders of 1, 3-1/2 and 10 inch diameter. In each case the surface jet was formed by a sharp edged annular orifice of width 0.5 inches with efflux velocities ranging from 50 to 170 feet per second. The theoretical and experimental results are generally in good agreement. Dissert. Abstr.

N68-22249# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON REASONS FOR THE FORMATION OF A RADIATION PEAK IN ATOMIC SPECTRUM LINES OF A NONEQUILIBRIUM
V. S. Vorob'ev and I. T. Iakubov [1968] 5 p refs Transl. into ENGLISH from Teplofiz. Vysokikh Temperatur, Akad. Nauk SSSR (Moscow), v. 5, no. 3, 1967 p 517–519

A mechanism for the origin of a radiation peak is proposed, and appropriate estimates and a comparison with experiment on shocks in air are made. An approximate method is used for solving the kinetic equations, and is based on the fact that a change in energy of the bound electron in an atom is described by a Fokker–Planck type diffusion equation upon transition from one state to another. The nonstationary problem is reduced to a quasi-stationary problem behind shocks with velocities in the 10 km/sec range. Author

N68-22255 Lockheed Missiles and Space Co., Palo Alto, Calif.
INVESTIGATION OF NITROGEN RADIATION IN THE NONEQUILIBRIUM DOMAIN BEHIND A SHOCK FRONT
G. D. Smekhov and S. A. Losev [1968] 7 p refs Transl. into ENGLISH from Zh. Prikl. Spektral'n. (USSR), v. 7, no. 4, 1967 p 589–593

Experiments are described which were conducted with a $0.1N_2 + 0.9Ar$ mixture to assure isothermal conditions with a temperature in the shock front not exceeding 11,000°K. The radiation in different portions of the spectrum was investigated, and a photoelectric recording method was employed. Results show that the radiation peak in the shock front belongs to cyanic radiation, and the peak after the shock front belongs to the nitrogen radiation. The radiation as a function of shock velocity and initial pressure was also studied, and graphs are included of the time to reach radiation maximums. N.E.N.

N68-22256 Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE MAXIMUM RADIATION OF A NONEQUILIBRIUM GAS BEHIND STRONG SHOCKS
I. T. Iakubov [1968] 4 p refs Transl. into ENGLISH from Teplofiz. Vysokikh Temperatur, Akad. Nauk SSSR (Moscow), v. 5, no. 3, 1967 p 515–517

A mechanism is proposed for the excitation of the radiation due to electron vibrational transitions into molecular ions. An illustration is given using molecular nitrogen ions, shock velocities greater than 10 km/sec, and collisions with electrons at small distances from the front. It is considered that under some conditions the molecular ion concentration greatly exceeds the equilibrium values. The ion excitation is accomplished by means of collisions with electrons in strong concentrations. N.E.N.

N68-22284 Lockheed Missiles and Space Co., Palo Alto, Calif.
AIR FLOW BEHIND A STRONG SHOCK FRONT TAKING ACCOUNT OF NONEQUILIBRIUM IONIZATION AND RADIATION
L. M. Biberman, V. S. Vorob'ev, A. N. Lagar'kov, V. P. Stulov, G. F. Telenin et al [1968] 16 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR (USSR), no. 6, 1967 p 46–57

The state of a gas behind a shock front in air with a velocity greater than 10 km/sec. is considered. Nonequilibrium ionization and radiation transport are taken into account. The actual air spectra, the numerous lines, bands, and continuum, are also considered. An integro-differential system of equations results whose method of solution is worked out. Profiles are obtained of the gas parameters behind the shock front due to relaxation processes and radiation cooling. In order to obtain results close to reality, only a gas layer bounded by the wave front and a parallel plane is considered. It is assumed that the gas bounded by these planes is not irradiated from outside. Author

N68-22298 New Hampshire Univ., Durham.
VIOLATION OF THE SECOND AND THIRD ADIABATIC INVARIANTS BY HYDROMAGNETIC WAVES
Barney Jay Conrath 1966 131 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-156

In this study two acceleration mechanisms are considered: violation of the second adiabatic invariant by small amplitude hydromagnetic waves and violation of the third adiabatic invariant by hydromagnetic waves of a large spatial scale. A review is given of the treatment of the motion of a charged particle in an electromagnetic field by means of the Allvèn perturbation method, along with a summary of the current experimental data available on the trapped particle regime. Violation of the second invariant is investigated, using a simplified model of converging field lines. Expressions for characteristic lifetimes and diffusions have been obtained and numerical examples are given. Violation of the third invariant by large scale magnetic disturbances with a sinusoidal dependence is investigated, using an image dipole model. Characteristic diffusion times are derived and the formulation is applied to an example of electrons with energies greater than 1.6 Mev at L=4. Dissert. Abstr.

N68-22310*# Martin Co., Orlando, Fla.
FLUIDIC DISPLAYS
J. Van der Heyden *In* NASA, Washington Recent Advan. in Display Media 1968 p 71–80 refs (See N68-22302 12-09)

This paper discusses recent developments in the field of fluidic displays and illustrates some of the areas in which fluidic display may be used. Some of the basic advantages of fluidic systems are discussed in the first section of this paper. The treatment of fluidic displays is subdivided into a section on conventional fluid display systems, which can be used in conjunction with fluidic systems, and a section that covers the fluidic displays especially developed for use with fluidic computers and control systems. In conclusion, some ideas that up to now have only been investigated in a cursory manner are presented as possible solutions to some of the problems associated with fluidic system displays. Author

N68-22346*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

THE LITERATURE OF LOW-G PROPELLANT BEHAVIOR

5 May 1967 45 p refs
(Contract NAS9-5174)
(NASA-CR-92081; LMSC-A874730) CFSTI: HC $3.00/MF $0.65 CSCL 20D

An annotated bibliography on low g fluid mechanics and heat transfer is presented. The areas covered include propellant location and interface shape, interface stability, reorientation, sloshing, propellant containment and ullage control, and draining. N.E.N.

N68-22353 Lockheed Missiles and Space Co., Sunnyvale, Calif.

SOLUTION OF THE NONSTATIONARY PROBLEM OF DIFFRACTION BY AN IMPEDANCE WEDGE WITH THE AID OF TABULATED FUNCTIONS

M. P. Sakharova and A. F. Filippov 1967 12 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 7, no. 3, 1967 p 568–579

The nonstationary problem of plane wave diffraction near the wave front uses a wedge with impedance boundary conditions; and is expressed by the Sommerfeld integral $\Psi_\phi(z)$, for which functions are tabulated. The reflected wave is shown, and analytic functions used to represent the solution are presented. The asymptotic expansion of the function $\Psi_\phi(z)$ for $\operatorname{Im} z \rightarrow +\infty$ is detailed, as is the asymptotic of the solution of the diffraction problem for $r/t \rightarrow 0$. M.W.R.

N68-22356 Rensselaer Polytechnic Inst., Troy, N. Y.

OSCILLATING VISCOUS FLOWS WITHIN AN ANNULUS

Edward Kiss (Ph.D. Thesis) 1966 88 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-4180

The theoretical solution of the problem of the oscillating viscous flow in the annulus between two long concentric tubes has been obtained for incompressible, isothermal, Newtonian liquids. The fluid motion is generated by a lineal periodic motion of the inner tube, while the outer tube is elastically supported by springs such that it is constrained to move parallel to its longitudinal axis. The analysis involves the simultaneous solution of the equation of motion for the fluid together with the equation of motion for the spring supported tube acted upon by a time varying fluid shear force. The type of flows assumed generated within the annulus are such that the convective acceleration terms in the Navier–Stokes equations identically vanish and an exact solution for laminar flow within the annulus is obtained. The velocity and shear stress in the fluid have been obtained and are expressed in terms of the Kelvin functions. Simplified approximate equations for velocity and shear stress are derived using asymptotic expansion relations. Dissert. Abstr.

N68-22398 Lockheed Missiles and Space Co., Palo Alto, Calif.

INVESTIGATION OF THE DYNAMIC RUPTURE STRENGTH OF WATER

T. P. Gavrilenko and M. E. Topchiian [1967] 4 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekhn. Fiz. (USSR), no. 4, 1966 p 172–174

Experimental investigations were conducted to determine the rupture strength of water under dynamic loading in the absence of a free surface. The test arrangement consisted of a hydraulic-pneumatic cylinder system with pistons, a membrane, and piezo-ceramic transducers. Tests were made with ordinary tap water both in the presence and in the absence of air bubbles. The results are graphically presented and briefly discussed. K.W.

N68-22403*# Lockheed Missiles and Space Co., Huntsville, Ala.

FORMULATION OF A METHOD FOR PREDICTING COUPLED CONVECTIVE AND RADIATIVE HEAT TRANSFER ABOUT A BLUNT BODY

L. W. Spradley and C. D. Engel Apr. 1968 51 p refs
(Contract NAS8-20082)
(NASA-CR-61200) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Formulation of a method for obtaining solutions to the radiation-coupled blunt body flow problem. The primary objective of the study is to develop a method for obtaining heating rate distributions about a blunt body in a hypersonic flow field for the case where convective and radiative transport mechanisms are coupled. A numerical iteration procedure is developed to obtain solutions to the system of nonlinear partial differential equations governing a thin shock layer which is completely viscous and radiating. Initial results of a digital computer implementation of the method are given with convective heating rates being compared to heating rates found in open literature. Author

N68-22424* Techtran Corp., Glen Burnie, Md.

PENETRATION OF A PLATE IN HALF PLANE WITHIN A SUPERSONIC FLOW [O PRONIKANII PLASTINKI V POLUPLOSKOST' SVERKHZVUKOVOGO POTOKA]

S. K. Betyayev Washington NASA May 1968 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR (Moscow), no. 2, 1967 p 33–37
(Contract NASw-1695)
(NASA-TT-F-11687) CFSTI: $3.00 CSCL 01A

An analysis is performed of the two-dimensional, self-similar problem of the even entry of a profile with a flat nose into the half plane of a homogeneous flow of an ideal, perfect gas. A numerical solution of the problem in the elliptic area is produced for a flow plan including one detached shock wave and a parabolic line originating at the angular point on the body. The solution is carried out numerically on a digital computer for various Mach numbers. Velocity and pressure distribution curves are obtained as functions of the similarity parameter β and the parameter k. Author

N68-22430 Lockheed Missiles and Space Co., Palo Alto, Calif.

ON SOME NONLINEAR PROBLEMS OF THE THEORY OF RADIATION TRANSFER IN SPECTRUM LINES

V. Iv. Terebizh [1968] 8 p refs Transl. into ENGLISH from Astrofiz. (Moscow), v. 3, no. 3, Aug. 1967 p 281–291

Diffusion of radiation in a plane isothermal gas layer consisting of two- or three-level atoms (in the latter case 1-2 transitions are forbidden) is considered. Forced radiation and frequency redistribution of quanta during scattering are taken into account. With the aid of the method of self-consistent optical depths, the problem is reduced to solving linear integral equations and to determining the true optical thicknesses of the layer at the centers of the lines from relationships connecting the X- and Y-functions or their moments. Author

N68-22505# Max-Planck-Institut fur Stromungsforschung, Gottingen (West Germany).

THE SPINNING VORTICES AS A SOURCE OF SOUND

E. A. Mueller and F. Obermeier *In* AGARD Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds Sep. 1967 9 p refs (See N68-22486 12-01)

Flow and sound field of a simple aerodynamic sound source—the two-dimensional spinning vortices—are calculated. In this calculation the method of matched asymptotic expansions is employed. This method for the solution of singular perturbation problems has been developed during the last years. It allows for the computation of an asymptotic solution of the differential equations of the flow, which is valid both in the near field and the far field. It is possible to generalize the above method to vortex flows and their radiation fields; results will be given. Author

N68-22555 Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON THE BOUNDARY LAYER IN A RADIATING GAS

L. M. Pavlova and Iu. D. Shmyglevskii 1964 8 p refs Transl. into ENGLISH from Prikl. Mekh. i Tekhn. Fiz. (USSR), no. 1, 1964 p 109–113

Simplification of equations for plane and axisymmetric radiating gas flows in the boundary layer on flat surfaces are considered. Cartesian coordinates are introduced, and the boundary layer equations are given for local thermodynamic equilibrium and averaging gas radiation with respect to frequencies. An equation of state is added, an optical thickness is considered, and inequality is derived to permit the simplification. To illustrate the use of the simplified equation, admissible values are found for the absorption coefficient for some flight conditions of a body of revolution with plane nose section. M.W.R.

N68-22627# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

A REVIEW OF TWO-PHASE LIQUID-VAPOR HYDRODYNAMICS AT LOW FLOW

J. B. Carr Dec. 1967 21 p refs
(Contract W-31-109-ENG-52)
(KAPL-3358) CFSTI: HC$3.00/MF$0.65

A review of the hydrodynamics of two-phase flow at low flow rates is presented. The flow oscillations, flooding, pressure drop, and dryout phenomena are discussed in relation to the cocurrent upflow, countercurrent flow, and cocurrent downflow modes that may exist. The analytical and experimental developments that are required to formulate a single analytical method spanning the cocurrent flow modes are roughly outlined. Author (NSA)

N68-22654# Aeronautical Research Council (Gt. Brit.)

A NEW TWO-PARAMETER FAMILY OF MEAN VELOCITY PROFILES FOR INCOMPRESSIBLE TURBULENT BOUNDARY LAYERS ON SMOOTH WALLS

B. G. J. Thompson 1967 64 p refs Supersedes ARC-26830; See X66-11955
(ARC-R+M-3463; ARC-26830) CFSTI: HC$3.00/MF$0.65

The combination of two universal functions, representing the effects of the wall and of the "intermittency" in the outer region, has been used to construct a new profile family. Charts are presented from which complete profileq and values of c_f and $H_{\delta-\delta^*}$ may readily be obtained for given values of H and R_θ. Comparisons with measured profiles are very satisfactory for a wide range of local and of upstream conditions, whilst the skin-friction values should be rather more reliable than those of the well-known Ludwieg and Tillmann relationship, especially when R_θ is less than 2000 or H exceeds 2.0. In severe adverse pressure gradients the 'universal' wall law breaks down and an estimate is given for the range of pressure gradient beyond which no two-parameter family is likely to be satisfactory. Author

N68-22733# Argonne National Lab., Ill.

FLOW OF RADIATING HYDROGEN IN AXIALLY SYMMETRICAL NOZZLES

V. V. Aleksandrov 1967 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza (USSR), no. 4, 1967 p 19–28
(ANL-TRANS-557) CFSTI: HC$3.00/MF$0.65

A method for the numerical calculation of a two-dimensional equilibrium flow of a nonviscous nonheat-conducting radiating gas with a variable absorption coefficient, such as radiating absorbing hydrogen in axially symmetrical nozzles is presented. It was assumed that the radiation is in local thermodynamic equilibrium; the flux of the radiation energy through the wall is equal to zero; the nozzles possess semiinfinite cylindrical entry parts; and initial gas flow is supersonic. The field of radiation density and flow parameters within the nozzle were calculated. NSA

N68-22790# Japan Society of Mechanical Engineers, Tokyo.

DISCHARGE OF SATURATED WATER FROM LONG DUCTS

Eio Ogasawara Oct. 1967 13 p refs Transl. into ENGLISH from Nippon Kikai Gakkai Rombunshu (Tokyo), v. 33, 1967 p 121–124 Presented at the 70th Ann. Meeting, Tokyo, Oct. 1967
(AEC-TR-6928) CFSTI: HC$3.00/MF$0.65

Theoretical studies of thermo- and fluid dynamic critical two-phase flow were tested experimentally by studying the discharge of water from long tubes. From the results of the study it was concluded that: the relationship between slip ratio and pressure predicted by theory was verified; the relationship between critical quantities was confirmed for critical pressures up to 40 atm; the effect of tube diameter is negligible up to 50.5 mm; critical pressure ratio increases with tube length for L/D below 10 and decreases slightly with length for L/D above 20; and two-phase critical flow can be treated as a primary elementary flow. Author (NSA)

N68-22813# Union Carbide Nuclear Co., Oak Ridge, Tenn. Computing Technology Center.

A NUMERICAL INVESTIGATION OF A CONFINED VORTEX PROBLEM

Robin E. Textor (M.S. Thesis—Tenn. Univ., Knoxville) 26 Jan. 1968 52 p refs
(K-1732) CFSTI: HC$3.00/MF$0.65

In terms of cylindrical coordinates, the Navier–Stokes equations and the equation of continuity are derived for axisymmetric, incompressible flows wherein the pressure is the only important external force. A problem is described in which a cylinder containing fluid and a coaxial tube are in rotation with one of the cylinder end walls at a constant angular velocity, the other cylinder and wall remaining stationary. A successive overrelaxation iterative procedure is described whereby the system of partial differential equations involving the classical stream function and vorticity are solved at steady-state. Some observations of the solutions thus obtained are made for tangential Reynolds numbers from 1 to 2000. Four other methods are discussed by which solutions of the problem either have been or may be attempted. Author (NSA)

N68-22819# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.

SOME EFFECTS OF MACROMOLECULES ON CAVITATION INCEPTION AND NOISE

Albert T. Ellis Jun. 1967 24 p refs
(Contract N60530-12164)
(AD-666012)

The investigation was of an exploratory nature and was undertaken to determine whether dilute solutions of macromolecules in water had any effect on flow generated cavitation inception and noise. The results reveal a definite inhibition of cavitation inception on a one-quarter inch diameter model with a hemispherical nose at flow velocities of forty to fifty feet per second. This effect was quite marked and at concentrations of fifty parts per million by weight polyethylene oxide reduced the cavitation parameter at inception by almost a factor of two. Noise from the cavitation as received from a transducer within the model appeared to decay in intensity soon after cavitation was established. This was not observed with water alone. Quantitative measurements of this effect were not attempted. A discussion of a possible mechanism for cavitation inhibition is given. Author (TAB)

N68-22859*# Louisiana State Univ., Baton Rouge.

FLOW LOSSES IN FLEXIBLE HOSE Summary Report

Sep. 1966 12 p
(Contract NAS9-4630)
(NASA-CR-62062) CFSTI: HC$3.00/MF$0.65 CSCL 20D

Equations are derived for predicting flow losses in flexible hose while using a gas and a liquid as test media. Parameters considered include: the effect of straight sections and bending, hose characteristics such as types of materials and convolutions, effective roughness factors, Reynolds number, and friction factors. Annular (both open and closed pitch convolutions were used) and helical hoses were tested under standard conditions using air and water as the test media. Experimental measurements of flow rate, pressure drop, and temperature are reported for a range of conditions. The temperature for the water system varied with the season while for the air system, a combination of season and compressor effects caused the temperature changes. The objectives of the research were accomplished in that (1) geometric parameters of the hose were investigated over proposed flow rates for rate ranges for the air and water system, and (2) correlations relating friction factor and Reynolds number are derived which gave satisfactory agreement between the values predicted and those measured. The data compiled and the derived correlations show that the friction factor for flexible hose increases with an increase in the flow rate and the corresponding Reynolds number. E.J.S.

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N68-21846# Kiruna Geophysical Observatory (Sweden).
ON THE SOLUTION OF THE INTEGRAL EQUATION RELATING HEIGHT DISTRIBUTION OF ELECTRON DENSITY TO RADIO WAVE ABSORPTION
Bengt Hultquist Aug. 1967 18 p refs
(KGO-673) CFSTI: HC$3.00/MF$0.65

The integral equation relating radio wave absorption, $A(\omega)$, to electron density profile in the quasilongitudinal case was solved for the absorption coefficient according to classical magnetoionic theory. Explicit formulas are given for the electron density distribution as a polynomial in $1n\nu$—which is very close to a linear function of height over a limited height interval—for the case when $(\omega \pm \omega_L) \cdot A(\omega \pm \omega_L)$ was determined as a polynomial in $\ln(\omega \pm \omega_L)$ from the absorption measurements. A numerical example is finally discussed. Author

N68-21847# Kiruna Geophysical Observatory (Sweden).
VLF SIGNAL PHASE INSTABILITIES PRODUCED BY PROPAGATION MEDIUM—EXPERIMENTAL RESULTS
F. H. Reder (Inst. for Exploratory Res.) and S. Westerlund 22 Dec. 1967 73 p refs Presented at the Proc. of AGARD-EWP on Phase and Frequency Instability in Radio Wave Propagation, Ankara, 9–12 Oct. 1967
(KGO-676) CFSTI: HC$3.00/MF$0.65

It is shown that utilization of the full potential of highly phase stable VLF signals in an undisturbed propagation medium requires a clear understanding of perturbations produced by transmitter and reception equipment. Signal phase instability is discussed for a quiet ionosphere in terms of diurnal and seasonal phase variations, and degrading effects due to mode conversion and mode interference. Phase instabilities during ionospheric disturbances are discussed in relation to six primary sources. Author

N68-21866 Kiruna Geophysical Observatory (Sweden).
KIRUNA GEOPHYSICAL DATA. DATA SUMMARY 66/3, JULY–SEPTEMBER 1966
Sep. 1966 45 p
CFSTI: $3.00

Tables of geomagnetic, optical and radio auroral, ionospheric ionization, radio wave propagation, and cosmic radiation data collected at the Kiruma Geophysical Observatory (67.8°N, 20.4°E) are presented for the period July–September 1966. E.J.S.

N68-21871 Kiruna Geophysical Observatory (Sweden).
KIRUNA GEOPHYSICAL DATA SUMMARY, OCTOBER–DECEMBER 1966
G. Gustafsson, ed. and L. Liszka, ed. Dec. 1966 52 p *Its* Data Sum. 66/4
CFSTI: $3.00

Data are tabulated for upper atmospheric geomagnetic, optical and radio auroral, ionospheric ionization, radio wave propagation, and cosmic radiation parameters recorded at the Kiruna Geophysical Observatory (67.8°N, 20.4°E) for October–December 1966. E.J.S.

N68-21872 Kiruna Geophysical Observatory (Sweden).
KIRUNA GEOPHYSICAL DATA SUMMARY, APRIL–JUNE 1966
G. Gustafsson, ed. and L. Liszka, ed. Jun. 1966 51 p *Its* Data Sum. 66/2
CFSTI: $3.00

Upper atmospheric geomagnetic, optical and radio auroral, ionospheric ionization, radio wave propagation, and cosmic radiation data collected at the Kiruna Geophysical Observatory (67.8°N, 20.4°E) are tabulated for the period April–June 1966. E.J.S.

N68-21889 Kiruna Geophysical Observatory (Sweden).
AURORAL ORIENTATION CURVES AND THE AURORAL OVAL
Georg Gustafsson Jan. 1968 23 p refs
(KGO-681) CFSTI: $3.00 CSCL 04A

A comparison was made between the auroral orientation curves and the auroral oval determined from the occurrence of the aurora. It was found that the auroral orientation curve crossing the midnight meridian at 67° corrected geomagnetic latitude is located within the auroral oval. The largest difference between the location of the auroral oval and the 67°-curve occurs in the morning hours and it was argued that the auroral orientation curve gives a better definition of the true auroral oval in this time interval. The auroral orientation curves were also related to the hydrogen emission and it has been found that the 66°-curve of auroral orientation represents the data except in the morning hours, where the data is ambiguous. Author

N68-21890# Aeronautical Chart and Information Center, St. Louis, Mo.
SOME DATA ON THE STRUCTURE OF THE UPPER MANTLE OF THE EARTH AND GENERAL SCHEME OF ISOSTASY
G. Z. Gurariy and I. A. Solov'yeva Jan. 1968 43 p refs Transl. into ENGLISH from the Russian
(ACIC-TC-1276; AD-666325)

The translation is a study of the problem of the structure of the deep parts of the earths crust and mantle. The authors of this work made a joint analysis of gravimetric and seismic studies of the terrestrial globe in order to specify the most general correlations between the thickness of the earths crust, the depth of occurrence of the Mohorovicic discontinuity, the relief and the value of the gravity anomalies in the Bouguer reduction. For the investigation of the causes of the observed deviations from the indicated general laws, methods of comparison between seismic and gravimetric data were worked out and a calculation of the density of the upper layers of the mantle at different points of the terrestrial globe was performed. For this work the 1:22,000,000 and 1:6,000,000 world and continental maps were used with the summary of materials on seismic investigations of the structure of the earths crust by the deep seismic sounding method and other methods. Author (TAB)

N68-21904*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PHASE AND GROUP REFRACTIVE INDICES FROM THE COLLISIONLESS MAGNETOIONIC THEORY

Lawrence Colin, Kwok-Long Chan, and Jack G. K. Lee (Informatics, Inc.) Washington Apr. 1968 130 p refs
(NASA-TM-X-1553) CFSTI: $3.00 CSCL 04A

Graphs of phase and group refractive indices computed from the collisionless magnetoionic theory are presented. The indices are computed for both the entire range of electron concentration and the intensity of the earth's magnetic field to be encountered by operational topside ionospheric sounders in the International Satellites for Ionospheric Studies (ISIS) series (Alouette I, Explorer XX, Alouette II, ISIS-A, ISIS-B). Author

N68-21935# Aeronautical Chart and Information Center, St. Louis, Mo.

UTILIZATION OF THE COMPLETE VERTICAL GRADIENT OF GRAVITY IN DETERMINING THE DEPTH OF THE ORIGINS OF GRAVITY ANOMALIES

V. M. Berezkin Jan. 1968 14 p refs Transl. into ENGLISH from Razved. i Promysl. Geofiz. (Moscow), Issue 18, 1967 p 69–79
(ACIC-TC-1344; AD-666324)

In the interest of increased accuracy of the gravimetric survey, the separation in the observed gravity field of small gravitational effects caused by such things as oil and gas deposits, sloping structures, ore bodies, etc. becomes very important. Most methods used to solve the transformation of gravitational field problems make it possible to note more positively, in comparison with visual evaluation, the presence of certain effects in the observed field, but give almost no information on the depth of occurrence of the disturbing masses, their form, etc. The Saksov and Nigard method makes it possible to obtain certain information on the depth to the center of the disturbing masses, but this information is often inadequate. The method which is discussed in this paper is mainly intended for conditions characterized by considerable differentation of density as for the exploration of ore deposits. The method of analytical continuation of the total vertical gravity gradient, down to the lower half-space (the two-dimentional case is being examined) through the disturbing masses with the aid of the mathematical instrument of Fourier series. Author (TAB)

N68-21948* Barringer Research, Ltd., Rexdale (Ontario).

ABSORPTION SPECTROSCOPY EXPERIMENT REMOTE SENSING OF TRACE GASES FROM ORBITAL ALTITUDES Final Report

Feb. 1968 35 p refs
(Contract NAS9-7241)
(NASA-CR-92064; TR-68-56) CFSTI: $3.00 CSCL 04A

A feasibility study to detect SO_2 emanations from geothermal and industrial sources from orbital altitudes involved the Barringer electronic correlation spectrometer and a newly developed imaging technique utilizing narrow band interference filters. The work was divided into three areas. The first was the radiative transfer problem for ultraviolet solar radiation. The objective was to obtain a value of reflected ultraviolet as seen from an aircraft and spacecraft for various conditions. The next area of investigation was the adaption and test of the electronic correlation SO_2 spectrometer for aircraft use and determination of limiting parameters. The last area was the testing and determination of the ultimate sensitivity of the differential imaging system. Author

N68-21992 Texas A&M Univ., College Station.

THE EVOLUTION OF CONVECTIVE MOTIONS IN A ROTATING FLUID: A NUMERICAL CALCULATION

Rex Lee Inman (Ph.D. Thesis) 1966 103 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-4707

The development of an incipient atmospheric vertical convective vortex has been investigated by numerical integration of an appropriate set of hydro-thermodynamic equations. In the numerical experiments the convective circulation is generated by a buoyant mass of air released in a shallow layer of the atmosphere. The fluid is specified to be in solid rotation about the z-axis, initially, with a constant angular velocity; the vertical vorticity acts as a source of angular momentum for the increase of tangential motion when air is brought inward toward the axis of rotation by the convective motions. Turbulent mixing of momentum, heat, and water substance is allowed explicitly in the model through the use of constant eddy coefficients. Dissert. Abstr.

N68-21993 Michigan Univ., Ann Arbor.

MEASUREMENT AND ANALYSIS OF THE STRUCTURE OF TURBULENCE NEAR THE GROUND WITH A HOT WIRE ANEMOMETER SYSTEM

Walter Gale Biggs (Ph.D. Thesis) 1966 137 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-1710

Spectral measurements of atmospheric turbulence near the ground have demonstrated for the periods examined the presence of a buoyant subrange at high frequencies. The existence of the buoyant subrange effectively precludes the establishment of local isotropy. In the present investigation, the configuration of hot wires was such that all three components of the wind were obtained. The spectral densities were computed for each wind component. These quantities were then analyzed to ascertain the degree to which they conform with Kolmogoroff's theory of local isotropy. The analysis shows the existence of a buoyant subrange at frequencies that are beyond the sensing capability of most meteorological instruments. The measurements were made at 1 m above the earth's surface in lapse conditions; local isotropy was not found in spite of the fact that excellent agreement with the −5/2 power law is shown relating the spectrum and the frequency. Dissert. Abstr.

N68-22009 General Electric Co., Syracuse, N. Y. Heavy Military Electronics Dept.

IONOSPHERIC PHASE FLUCTUATIONS OF SATELLITE TRANSMISSIONS

G. H. Millman and R. E. Anderson 15 Oct. 1967 27 p refs
(R67EMI126)

The coherent frequencies of 162 and 324 MHz emitted from the GEOS-1, Explorer 29 satellite were used to study the phase fluctuations imposed by irregularities in the ionosphere. The observations were conducted at a midlatitude station in May and June 1966. From accurate frequency measurements, the total columnar electron content was determined by the Doppler slope method for approximately overhead satellite passes at closest approach. The spatial variation of the electron content was deduced from the differential phase measurements recorded throughout the satellite passes. At times, unusual phase fluctuations were observed which were most likely caused by ionospheric inhomogeneities located in the path of propagation. The characteristics of the phase fluctuation data are presented. Correlation of all the experimental data with solar-geophysical conditions is also discussed. Author

N68-22011# Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique.

SOIL CONGEALING. 7: EXPERIMENTS IN THE ONE-DIMENSIONAL CONGEALATION OF DIFFERENT SOIL

SAMPLES [GELIVITE DES SOLS. 7: ETUDE EXPERIMENTALE DE LA CONGELATION UNIDIMENSIONNELLE DE DIFFERENTS ECNATILLONS DE SOL]
Jaime Aguirre Puente and Bernard Le Fur Dec. 1967 27 p refs In FRENCH
(Rept.-67-9) CFSTI: HC$3.00/MF$0.65

Congealment mechanisms in granular and fine soils are discussed, and details are given on an experimental installation designed for soil temperature measurements. The soil samples are placed in a cylindrical container, with one side subjected to falling temperatures and the other to a constant warm temperature. Provisions for observing the thermal behavior and congealment mechanisms are included. Three types of soil were examined to determine their particular cryogenic characteristics. Temperature profiles for each type are plotted, and the parameters affecting the course of congealment are defined. Transl. by M.G.J.

N68-22029 Pittsburgh Univ., Pa.
ROCKET DETERMINATION OF THE DAYTIME SODIUM DISTRIBUTION IN THE UPPER ATMOSPHERE
Robert Richard Meier (Ph.D. Thesis) 1966 110 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-4570

A rocket photometer was successfully flown on September 26, 1964, with the purpose of measuring the altitude profile of sodium in the daytime. The sodium was discovered to be concentrated in a very narrow layer of only 5 km. full width of half maximum density centered at 92.4 km. The peak density was 2.8×10^4 atoms/cm^3. Since this distribution is inconsistent with a photochemical-diffusion theory based on the assumption of a non-local source of sodium, a new model is proposed in which charged, sodium-containing aerosol particles are concentrated into a very narrow layer by means of a wind shear mechanism. Sodium is then liberated through the action of solar radiation. The atoms diffuse away from the source until they are either oxidized by ozone or ionized. This removal must take place in a time which is of the order of the diffusion time in order to produce a narrow sodium distribution. It is quantitatively shown that the proposed model fits the experimental results under somewhat simplified conditions. Dissert. Abstr.

N68-22057 Stanford Univ., Calif.
THE DYNAMICS OF WIND IN THE VICINITY OF PROGRESSIVE WATER WAVES
Omar Hazim Shemdin (Ph.D. Thesis) 1966 226 p
Available from Univ. Microfilm: HC $10.35/MF $3.00 Order No. 67-4434

The normal pressure distribution and the structure of the velocity profile immediately above progressive water waves are investigated. The theory of Miles on the generation of surface waves by shear flows predicts a phase shift between the pressure distribution along a wavy surface and the wave itself. This shift becomes responsible for the transfer of energy from air to water due to normal pressure, thereby causing the waves to grow. An experimental verification of this theory is sought especially. Dissert. Abstr.

N68-22074 California Univ., Berkeley.
ELECTRON DENSITIES IN H2 REGIONS FROM OBSERVATIONS AT 4 CM
Ashley Anthony Cunningham (Ph.D. Thesis) 1966 54 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-5040

Observations of NGC 6523, NGC 6611, NGC 7000, and IC 410 were made with the University of California 85-foot radio telescope, at a wavelength of 4 cm. Using spherical models, one-dimensional electron density distributions were computed at an electron temperature of 8000°K. From the density profiles, the ages of these diffuse nebulae were estimated. These ages are considerably shorter than the element-burning lifetimes of the exciting stars. Dissert. Abstr.

N68-22093# Kiruna Geophysical Observatory (Sweden).
AURORAL PARTICLES: A REVIEW
Bengt Hultqvist [1967] 39 p refs Presented at the Birkeland Symp., Sandefjord, Norway, Sep. 1967
(KGO-675) CFSTI: HC$3.00/MF$0.65

A review is given of auroral electron and proton measurements in the last three years. The distribution over the earth's surface of the precipitation, the flux and energy spectrum of auroral protons, the intensity of electron precipitation, the electron spectrum, correlation between variations in intensity of electron precipitation and in energy spectrum, the pitch-angle distribution, backscattering of particles, velocity dispersion of electrons, high-latitude electron spikes, and relations between auroral particle precipitation and upper atmosphere effects are treated. Some comments, based on the experimental results reviewed, are made of auroral particle acceleration models. Author

N68-22109*# Little (Arthur D.), Inc., Cambridge, Mass.
A STUDY OF DYNAMICS OF MAGMA EXTRUSION AND INVESTIGATION OF VOLCANIC VAPOR Final Report, 25 Mar. 1966–30 Jun. 1967
Robert K. McConnell, Jr., Leslie A. McClaine, and Ronald V. Allen Jul. 1967 196 p refs
(Contract NAS9-5839)
(NASA-CR-62060; C-68231) CFSTI: HC $3.00/MF $0.65 CSCL 08D

The program to develop a quantitative model for igneous activity which is consistent with terrestrial observations and suitable for extrapolation to the moon. In this report the heat flow model is revised to incorporate and to obtain consistency with the information relating to continental drift, terrestrial heat flow, and crustal and mantle structure. The implications of this model for mantle composition are considered. Much of the available geochemical data for tholeiitic magmas is reviewed and a hypothesis consistent with the data is developed which interprets the observed terrestrial variations in magma composition in terms of the depth of origin of the magma. It is concluded that if the moon has the same composition as the one inferred for the earth's mantle, early volcanism is almost inevitable. Data gathered to date for use in development of a quantitative model for magma approaching the surface is presented. Included are the results of literature reviews and experimental studies on gases dissolved in magmas, the volatility of basalt, and "smoke" particles derived from condensation of volcanic vapors. Author

N68-22117# Kiruna Geophysical Observatory (Sweden).
FARADAY ROTATION OBSERVATIONS USING A ROTATING ANTENNA
Ludwik Liszka and Andrzej Wernik Dec. 1967 7 p ref
(KGO-678) CFSTI: HC$3.00/MF$0.65

The relation between periods of Faraday rotation observed by a rotating antenna and a fixed antenna is discussed. It is pointed out that in cases where the polarization plane of satellite signals rotates slowly, fixed antenna recordings give very few points for determining the total amount of rotation. A simple method is proposed for increasing the accuracy of measurement in such cases, based on the use of an antenna uniformly rotating in the horizontal plane. B.S.D.

N68-22160 New York Univ., N. Y.
FAST NEUTRON LATITUDE VARIATIONS IN THE ATMOSPHERE AT SOLAR MINIMUM
Stephen S. Holt (Ph.D. Thesis) 1966 159 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-6030

Six high-altitude balloon flights carrying phoswich-type fast neutron scintillation detectors were launched between September 1964 and March 1965. The flights attained altitudes of about 120,000 feet at Sioux Falls, S.D., geomagnetic latitude 53°N; at Palestine, Texas, geomagnetic latitude 42°N; and at Hyderabad, India, geomagnetic latitude 8°N. The detector was sensitive to neutrons in the energy range 1 to 10 MeV, and a seven-channel light-pulse analyzer permitted the evaluation of the energy spectrum. Data were obtained from ground level to about 4 g/cm^2 at the three latitudes; an extrapolation technique was used to estimate the neutron albedo. Data were used from a flight from Fort Churchill, Canada, geomagnetic latitude 69°N, during August 1965 in the evaluation of the variations of neutron flux and energy spectrum with altitude and latitude at solar minimum.

Dissert. Abstr.

N68-22238 Oregon State Univ., Corvallis.

ATTENUATION OF COMPRESSIONAL WAVES IN THE EARTH'S MANTLE

Suryya Kanta Sarmah (Ph.D. Thesis) 1967 88 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-5407

Fourier transformed amplitudes of the compressional waves recorded between 9° and 91° (about 1000 to 10,000 km) epicentral distance from Gnome, Shoal, Haymaker, and Bilby underground nuclear explosions were compared with Fourier transformed amplitudes of P waves measured at distances between 9.0 and 13.0 km from the explosions. Apparent Qs computed for frequency ranges of 0.5 to 1.0 cps and 0.7 to 1.0 cps at the various epicentral distances indicate that the mantle is inhomogeneous with respect to the absorption of seismic energy. Relatively low Q (high absorption) regions are centered around 25°, 42° and 74° and high Q (low absorption) regions are centered around 20°, 31°, 71°, and 78° epicentral distances. These are superimposed on a gradually increasing Q with epicentral distance trend. The average apparent Q value for the upper mantle is found to be 286±38. The highest Q value of this study occurs between 78° and 80° epicentral distance where it is greater than 3000. Dissert. Abstr.

N68-22239 British Columbia Univ., Vancouver.

THE CHARACTERISTICS AND WORLD-WIDE PROPAGATION OF PI 2 MICROPULSATIONS

Gordon Rostoker (Ph.D. Thesis) 1966 263 p
Available from Natl. Library of Can. at Ottawa: MF $3.50

To study the propagation characteristics of Pi 2 micropulsations, a set of five fluxgate magnetometer units was set up stretching across the continent from Victoria, B.C. to Montreal, P.Q. with all stations lying on approximately geomagnetic latitude 56°N. Continuous recordings of H, D, and a filtered H component (bandpass 25–200 sec.) were made from June 1 through August 15, 1965. Further information on pertinent disturbances was obtained from stations distributed over the continents of North America and Antarctica. The mode of propagation most likely responsible for the transfer of Pi 2 activity from high to mid latitudes could be described by a plane electromagnetic wave propagating approximately normal to the earth's magnetic field lines through the lower E-region of the ionosphere. It is found that the maximum period in a Pi 2 event increases with increasing K_p index in the range $K_p \sim 0$ + to 2o, and that the number of peaks in the frequency spectrum of a Pi 2 event increases approximately linearly with increasing K_p.

Dissert. Abstr.

N68-22261*# National Aeronautics and Space Administration, Washington, D. C.

CURRENT PROGRAM AND CONSIDERATIONS OF THE FUTURE FOR EARTH RESOURCES SURVEY

Homer E. Newell 16 Apr. 1968 17 p Presented at 5th Symp. on Remote Sensing of Environment, Ann Arbor, Mich., 16 Apr. 1968 *Its* NASA Press.Kit
CFSTI: HC$3.00/MF$0.65 CSCL 04A

An overview is presented on the advances in satellite sensing programs during the 1962–1968 period, and current needs and problem areas are assessed. Progress in establishing an operational meteorological satellite program is discussed, with major achievements cited as the automatic picture transmission systems initiated with Tiros 8, high resolution infrared imagery allowing nighttime cloud cover mapping introduced with Nimbus 1, spin stabilization in sun synchronous orbit achieved with Tiros 10, the operational advanced vidicon camera system of Essa 2, and the synchronous orbital satellite ATS-1. The Geodetic Satellite Program is reviewed, along with the application of remote sensing techniques in the field of oceanography. Data requirements are identified for studies on forestry, agriculture, geography, hydrology, and geology. Future plans are outlined, and the need of providing a data handling and distribution network, and of organizing it into an overall workable system, is stressed. M.G.J.

N68-22273# Manufacture Belge de Lampes et de Materiel Electronique, Brussels (Belgium).

GROUND PRINCIPLE OF SUBOPTIMAL PERTURBATIONAL GUIDANCE SYSTEM AND POLYNOMIAL APPROXIMATION OF GUIDANCE MATRICES [PRINCIPES DU GUIDAGE PERTURBATIONNEL SUBOPTIMAL ET METHODES D'APROXIMATION POLYNOMIALE DES MATRICES DE GUIDAGE]

Y. Genin [1966] 17 p refs In FRENCH *Its* MBLE Rev., Vol. 9, No. 2
CFSTI: HC$3.00/MF$0.65

The problem of optimal guidance is posed for a space vehicle, and a solution based on the linearization of equations of motion is given for a precalculated nominal trajectory. It is shown that this method requires knowledge of a guidance matrix, and approximating a polynomial for this matrix is detailed. The methods used are applied to a mission of ELDO 1. Transl. by M.W.R.

N68-22350*# New York Univ., N. Y. Dept. of Mechanical Engineering.

PROPAGATION OF LOVE WAVES IN LAYERS WITH IRREGULAR BOUNDARIES

Barry Wolf Apr. 1968 19 p refs
(Grant NGR-33-016-067)
(NASA-CR-94362; S-68-1) CFSTI: HC $3.00/MF $0.65 CSCL 08K

Love waves in the earth were studied by a model in which the half space is elastic, and consideration is given to the field resulting when a horizontally polarized shear wave, propagating in the plane portion of an elastic layer, is incident on the irregular portion. In order to arrive at a scattered field, a solution is assumed in the form of a contour integral; and expressions for the displacement field satisfy the wave equations and the boundary condition. A perturbation procedure is used for the solution of the integral equation for the case of boundaries having small irregularities. The integrals are evaluated, the contour is closed, and the singularities of the integrands are found within this closed contour. An appendix deals with roots of the characteristic equation in the classical Love wave problem. M.W.R.

N68-22402*# Maryland Univ., College Park. The Inst. for Fluid Dynamics and Applied Mathematics.

ENVIRONMENT MODIFICATION EXPERIMENTS IN SPACE

Mar. 1968 219 p refs
(Grant NSG-220-62)
(NASA-CR-94330) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Seven papers are presented which discuss investigations into the dynamics of field, particle, and plasma processes in the magnetosphere. A table is given listing proposed experiments using injected electron beams, ion beams, plasmas from alkali metals, and injected electromagnetic waves. Topics covered in the seven papers are: generation of artificial aurorae, creation of an artificial Van Allen Belt, plasma effects of electron beams injected into space, triggering in aurora, study of magnetospheric electric and magnetic fields using tracer techniques, modification of the magnetospheric convection pattern, and wave-particle interaction experiments. Power availability data is included for the uprated Saturn I, the Saturn V, and other power supplies for earth orbital missions. E.C.

N68-22462*# Scientific Translation Service, La Canada, Calif.

SCATTERING OF LIGHT IN A TURBID MEDIUM

K. S. Shifrin Washington NASA Apr. 1968 217 p refs Transl. into ENGLISH of the book "Rasseyaniye Sveta v Mutnoy Srede" Moscow, Gosgeoltekhizdat., 1951 p 1–212
(Contract NASw-1496)
(NASA-TT-F-477) CFSTI: $3.00 CSCL 04A

Presented is a systematic discussion of the theory of scattering and absorption of plane electromagnetic waves by particles of a turbid medium. Considered in the discussion are the following: linear dimensions of the particles, their electrical characteristics, and a general formulation of the problem of perturbation introduced by a particle into a field; fundamental formulas; partial waves; small particles; large particles; absorbing and fully reflecting particles having any dimensions; and particles with electrical properties deviating slightly from the surrounding medium properties. S.C.W.

N68-22479# Joint Publications Research Center, Washington, D. C.

SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NUMBER 179

6 May 1968 93 p Transl. into ENGLISH from Russian
(JPRS-45279) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. ASTRONOMY p 1–8 refs (See N68-22480 12-30)
2. METEOROLOGY p 9–39 refs (See N68-22481 12-20)
3. OCEANOGRAPHY p 40–60 refs (See N68-22482 12-13)
4. TERRESTRIAL GEOPHYSICS p 61–76 refs (See N68-22483 12-13)
5. UPPER ATMOSPHERE AND SPACE RESEARCH p 77–116 refs (See N68-22484 12-13)

N68-22482# Joint Publications Research Center, Washington, D. C.

OCEANOGRAPHY

In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 179 6 May 1968 p 40–60 refs (See N68-22479 12-13)

Oceanographic studies by Soviet bloc scientists are summarized; and various mathematical approaches to solving oceanographic problems are noted. Abstracts cover subjects such as the composition of ocean water, radioactive contamination in the water, melting of glaciers, and wind effects. News reviews are presented for several research facilities, of existing services, and instruments of use in oceanographic studies. Other abstracts deal with spectral theory of wind driven currents, deformation of ocean waves, and deposits on the ocean floor. M.W.R.

N68-22483# Joint Publications Research Center, Washington, D. C.

TERRESTRIAL GEOPHYSICS

In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 179 6 May 1968 p 61–76 refs (See N68-22479 12-13)

Reports summarized deal with desert earthquakes, mountain drilling and blasting, seismic stations, and instrumentation of value to terrestrial geophysics research. Abstracts of scientific articles from the Soviet-bloc literature cover magnetic field strength, seismic wave absorption, the earth crust and mantle, and use of geophysical data to study volcanic formations. Computing arrays and studying surface waves in seismic prospecting is covered, as are geomagnetic field pulsations and magnetic storms and magnetically conjugate points. M.W.R.

N68-22484# Joint Publications Research Center, Washington, D. C.

UPPER ATMOSPHERE AND SPACE RESEARCH

In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 179 6 May 1968 p 77–116 refs (See N68-22479 12-13)

Several TASS reports dealing with Cosmos and Lunik launches are presented, and mention is made of joint Soviet-French polar latitude upper atmosphere research efforts. Abstracts of scientific activities of Soviet bloc countries consider optimal control during atmospheric reentry, measuring cosmic ray intensities, variations in geomagnetic fields, and planetary and interplanetary studies. Polar cap auroras and variation of absorption in the auroral zone, genetic studies of lysogenic bacteria, and magnetosphere studies are abstracted. Other topics reported are neutron flux aboard Cosmos 53, lunar X-irradiation, electron density in the lower ionosphere, and ionization created by satellites in the upper atmosphere. Kinetic parameters of ionization-recombination processes, stability of a variable mass rotating body, global properties of noctilucent clouds, and electrophotometric measurements of short period variations are covered. M.W.R.

N68-22628# Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.

ON THE DYNAMICS OF THE THERMOSPHERE

C. Pablo Lagos 1 Sep. 1967 141 p refs
(Contract AT(30-1)-2241)
(MIT-2241-35; Rept.-20) CFSTI: HC $3.00/MF $0.65

A dynamically consistent set of simplified equations applicable to large-scale motion in the thermosphere is rigorously developed from the Navier–Stokes equations. The simplifications are justified by means of a scale analysis. These equations form a basis of the dynamics of the thermosphere. Sources and sinks of energy are discussed and analytic solutions of the heat conduction equation are obtained, using a Green's function technique. The diurnal pattern of heating and the accompanying structural changes in the thermosphere is first studied in a numerical model depending only upon altitude and time. The energy sources are taken to be solar heating, radiation cooling, and conduction. No explicit account is taken of horizontal variation and horizontal motion in the model. Comparison of model structure with the observed structure of the thermosphere points to the existence of large-scale poleward transport of heat by horizontal motion in the thermosphere. The transport is required in middle and high latitudes at equinox and at all latitudes in the winter hemisphere near the solstice. When explicit account is taken of the horizontal variation and the equations of motion are included, a dynamical model of the thermosphere is obtained. The full set of equations are discussed. A two-dimensional model, allowing no latitudinal variation, is used to study the effect of horizontal motions on the phase and amplitude of the diurnal temperature oscillation. Under these conditions the computations indicate: (1) horizontal energy transport by advective processes cannot modify the phase of the diurnal temperature oscillation; (2) adiabatic heating and cooling by vertical motion provides a heat source in the thermosphere. With vertical motions included, the calculated maximum temperature shifts from about 1800 local time, as calculated from the one-dimensional model, to about 1m00 local time, as is observed. Author (NSA)

N68-22699# Commissariat a l'Energie Atomique, Grenoble (France).

DIFFERENTIAL MEASUREMENT OF THE EARTH'S MAGNETIC FIELD BY NUCLEAR MAGNETIC RESONANCE [MESURE DIFFERENTIELLE DU CHAMP NAGNETIQUE TERRESTRE PAR RESONANCE MAGNETIQUE NUCLEAIRE]

Francis Robach (Ph.D. Thesis—Grenoble Univ.) 1967 93 p refs In FRENCH
(CEA-R-3121) CFSTI: HC$3.00/MF$0.65

Geomagnetic field variations can be converted into phase measurements by NMR transducers with proton dynamic polarization. Several versions of such instruments are analyzed in detail, with emphasis on alignment of the instrument in relation to the geomagnetic field. A sensitivity of 0.01 γ over a bandwidth of 0 to 0.1 Hz is attainable. These instruments are designed for measuring field gradients in airborne magnetic surveys, for short-range detection of magnetic anomalies, and for distinguishing between nearby and distant magnetic phenomena. K.W.

N68-22763# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.

GRAVIMETRIC INVESTIGATIONS IN THE REGION OF KURIL-KAMCHATKA TRENCH AND THE NORTHWESTERN PACIFIC IN 1958

V. A. Gladun Jan. 1968 18 p refs Transl. into ENGLISH from the publ. "Morskiye Gravimetricheskiye Issledovaniya" Moscow, Moscow Univ. Publishing House, Issue 2, 1958–1960 p 77–85
(ACIC-TC-1274; AD-666323)

In accordance with the International Geophysical Year of 1957-1958, the complex operations on the study of the Kuril-Kamchatka transition zone from the Asian continent to the Pacific Ocean were included in the plan of Soviet Investigations. The main geophysical observations were carried out in the northern part of the transition zone, which covers the Sea of Okhotsk, the Sakhalin Island, the northern group of the Kuril Islands, the southern part of Kamchatka, the Commander Islands, and the adjacent part of the Kuril-Kamchatka bathypelagic depression. The geophysical observations in question were performed by seismic, seismological, gravimetric and magnetic methods. Deep seismic sounding was the main method of this multiple investigation. Author (TAB)

N68-22769*# Massachusetts Inst. of Tech., Cambridge.

HYDROSTATIC SEA LEVEL CHANGES

G. Welch [1968] 6 p refs
(Grant NGR-22-009-250)
(NASA-CR-94354) CFSTI: HC$3.00/MF$0.65 CSCL 08C

The effects of the inverted barometer and of steric changes on the hydrostatic response of the ocean are assessed, and the Navier–Stokes equation is used to derive the basic hydrostatic equation. The specific volume of sea water is defined as a function of pressure, salinity, and temperature which may be expressed as the specific volume under standard conditions, plus the effects of deviations in these three variables. Methods of obtaining and evaluating data on sea level observations, atmospheric pressure, temperature profiles, and salinity are discussed. Consideration is also given to steric anomalies due to temperature and salinity variations. It was found that the total hydrostatic response at the time periods studied appears to agree with recorded sea level changes over almost all oceans, although a significant difference associated with coastal effects was noted near some coasts. Summarized results show that for periods of less than a year the variations are pressure-dominated by latitudes greater than 40°, and temperature-dominated at lower latitudes. M.G.J.

N68-22773*# Miami Univ., Coral Gables, Fla. Inst. of Molecular Evolution.

RESEARCH RELATING TO LUNAR STUDIES Annual Report, 1 Mar. 1967–28 Feb. 1968

28 Feb. 1968 14 p
(Grant NGR-10-007-044)
(NASA-CR-94423) CFSTI: HC$3.00/MF$0.65 CSCL 06D

Those aspects of studies of organic geochemistry of terrestrial samples, of meteorites, and those aspects of laboratory studies of the origin of life-related substances and systems which serve as preparation for lunar studies are described. Studies related to lunar analysis are considered with respect to the analysis of amino acids and amino acid polymers in volcanic samples and various carbonaceous fractions. Among the studies included are (1) prebiological chemistry of hydrogen cyanide, (2) synthesis of optically active α-amino acids for α-keto acids by reductive amination, (3) organic chemical studies of the carbonaceous constituents of various meteorites, (4) organic geochemistry of carbonaceous complexes of juvenile magnetic origin, and (5) comparative studies of carbonaceous complexes. B.S.D.

N68-22821# Defense Intelligence Agency, Washington, D. C.

A DOD GLOSSARY OF MAPPING, CHARTING AND GEODETIC TERMS

Jul. 1967 236 p refs 1st Ed.
(AD-666989)

The terms and definitions appearing in this publication were selected from existing glossaries and dictionaries, authoritative military and civilian sources, and technical publications and papers dealing with the various disciplines that make up the field of mapping, charting, and geodesy. For the most part, only those terms considered germane to some specific aspect of mapping, charting, and geodesy are included. In the peripheral or associated areas, such as photography, lithography, optics mathematics, etc., only such basic terms were included as were considered necessary to establish a commonalty of language and, therefore, a means of better communication between these disciplines. Author (TAB)

N68-22827# Washington Univ., Seattle. Dept. of Oceanography.

PHYSICAL, CHEMICAL, AND BIOLOGICAL DATA FROM THE NORTHEAST PACIFIC OCEAN: COLUMBIA RIVER EFFLUENT AREA, 1965. VOLUME 1: BROWN BEAR CRUISE 352, 11–28 JANUARY. BROWN BEAR CRUISE 357, 14–28 APRIL. BROWN BEAR CRUISE 368, 4–22 AUGUST. BROWN BEAR CRUISE 380, 3–18 NOVEMBER

Clifford A. Barnes Feb. 1967 330 p refs
(Contracts AT(45-1)-1725; Nonr-477(37))
(RLO-1725-91; TR-182, V. 1) CFSTI: HC$3.00/MF$0.65

Tabulated physical, chemical, and biological data collected during cruises 352, 357, 368 and 380 of the Research Vessel Brown Bear during 1965 in an area within 650 nautical miles of the coasts of Washington and Oregon are presented. These data were collected as part of a year-round study to determine the properties, distribution, and movement of the Columbia River effluent water in the Northeast Pacific. Author (NSA)

N68-22841# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.

RESEARCH ON BUOYANT PLUMES Annual Report, 1967

Jan. 1968 120 p refs
(Contract AT(30-1)-3685)
(NYO-3685-13) CFSTI: HC$3.00/MF$0.65

Full-scale plume rise studies were performed at the Lakeview (Toronto) power station. New experimental equipment and techniques employed are described including an experimental but reliable method for obtaining the lapse rate at heights of 2000 ft in moderate to high winds. A kite was designed to lift a tethersonde. The kite maintains the sonde at a steady height even in gusty winds. Results obtained describe the behavior of the chimney plumes under all stable conditions. Completed full-scale observations are described. Laboratory simulation of thermals provide information on buoyant motion. Observations of model plumes observed in

Western Ontario's large wind tunnel were completed and described. A theoretical explanation of the complex actual behavior of plumes in a stable or unstable atmosphere is given. The need for an experimental investigation of the fluctuation problem in atmospheric distribution is described. NSA

N68-22856# Washington Univ., Seattle. Dept. of Oceanography.
PHYSICAL, CHEMICAL, AND BIOLOGICAL DATA FROM THE NORTHEAST PACIFIC OCEAN: COLUMBIA RIVER EFFLUENT AREA, 1965. VOLUME 2: BROWN BEAR CRUISE 353, 9–19 FEBRUARY. BROWN BEAR CRUISE 354, 19–26 MARCH. BROWN BEAR CRUISE 355, 29 MARCH–6 APRIL. BROWN BEAR CRUISE 356, 9–12 APRIL. BROWN BEAR CRUISE 365, 11–20 JUNE. BROWN BEAR CRUISE 367, 2–7 JULY. BROWN BEAR CRUISE 371, 14–26 SEPTEMBER
Clifford A. Barnes Feb. 1967 320 p refs
(Contracts AT(45-1)-1725; Nonr-477(37))
(RLO-1725-92, V. 2; TR-182, V. 2) CFSTI: HC $3.00/MF $0.65

Tabulated physical, biological, and chemical data collected during cruises 353, 354, 355, 356, 365, 367, and 371 of the Research Vessel Brown Bear during 1965 in an area within 100 nautical miles of the coasts of Washington and Oregon are presented. These data were collected as part of a year-round study to determine the properties, distribution, and movement of the Columbia River effluent water in the Northeast Pacific. Author (NSA)

N68-22861*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, N. Y.
RADIATIVE EQUILIBRIUM IN AN ATMOSPHERE WITH CONSTANT EINSTEIN ABSORPTION COEFFICIENT
Rupert Wildt and Sandra Schwartz Washington May 1968 51 p refs
(NASA-TN-D-4479) CFSTI: HC $3.00/MF $0.65 CSCL 04A

In the classical gray atmosphere, the phenomenological coefficient of absorption that enters into Kirchhoff's law is assumed to be independent of the frequency ($\kappa_\nu = \mathrm{const} = \kappa^{-}$). Strictly considered, this coefficient is the product obtained by multiplying the Einstein coefficient of true absorption by a frequency-dependent correction for induced emission (Rosseland factor). The alternative here examined is to set the Einstein coefficient constant, incorporate the effects of induced emission into the transfer formalism, and determine the march of the local thermodynamic equilibrium source function by numerical iteration. This second kind of gray atmosphere differs markedly from the classical one in respect to many physical characteristics and represents, in conventional terminology, the simplest nongray problem that is physically realistic. Author

N68-22924*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPERIMENTAL APPROACHES TO REMOTE ATMOSPHERIC PROBING IN THE INFRARED FROM SATELLITES
William R. Bandeen May 1968 54 p refs
(NASA-TM-X-63188; X-622-68-146) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Remote atmospheric probing in the infrared from satellites had its inception in October 1959 with the launch of Explorer VII carrying a simple wide field radiometer. Since that time much progress has been made in developing radiometric instruments of increasing spatial and spectral resolution. Thirteen different types of radiometric instruments either have been flown in orbit or are scheduled to fly on forthcoming satellites. A fourteenth type, a very high resolution radiometer for geosynchronous altitude, is among several of the others whose development has been stressed for the Global Atmospheric Research Program (GARP) of the next decade. Hence, even though it is not yet approved for flight, this instrument is included in this survey of experimental approaches to remote atmospheric probing in the infrared from satellites, developed during the first decade of the space age. Characteristics of each radiometric instrument and some applications of the different types of data are discussed. Author

N68-22969# Environmental Research Corp., Alexandria, Va.
AMPLIFICATION OF SEISMIC BODY WAVES BY LOW VELOCITY SURFACE LAYERS
A. H. Davis and J. R. Murphy 19 Dec. 1967 77 p refs
(Contract AT(29-2)-1163)
(NVO-1163-130) CFSTI: HC $3.00/MF $0.65

A theory is developed to predict the amplification of seismic body waves by a layer of alluvium. The theory is based on a model consisting of a single layer of alluvium lying above an infinite half-space of hardrock, with seismic waves incident from below. The amplification factor, defined as the ratio of the amplitude spectrum of the signal at the surface of the layer to the amplitude spectrum of the signal at a hardwork surface without any layer, is compared with observations made at two sites where such signals are available. The main body wave resonance of the layer can be predicted with fair accuracy. Suggestions for further studies and recommendations for additional instrumentation at favorable sites are included. Author (NSA)

N68-22982# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
PRESHOT GEOLOGIC AND ENGINEERING PROPERTIES INVESTIGATIONS: PROJECT PRE-SCHOONER 2
Richard J. Lutton, Frank E. Girucky, Richard W. Hunt, and Joseph R. Curro, Jr. Oct. 1967 112 p refs
(PNE-509) CFSTI: HC $3.00/MF $0.65

The Pre-Schooner II site was selected, from five areas investigated, on the basis of refraction seismic surveying, core drilling, and surface mapping in extrusive igneous rock that generally models the nearby Schooner site. Bedrock below about 5 feet of stony silt consists of a 25-foot-thick layer of vitrophyre and vitrophyre breccia over felsite that extends to a depth of at least 150 feet. These two bedrock layers at the site have distinctly different physical properties, the felsite being relatively less porous and stronger in compression than the overlying vitrophyre. The felsite is massive at depth, although highly fractured, but it becomes steeply flow-layered in the upper portion. The flow layers continue across a gradational zone into the overlying vitrophyre. The resultant structure strikes about north 35 degrees east. The felsite is conspicuously jointed, and the vitrophyre contains abundant microscopic cracks. Author (NSA)

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N68-21884*# Honeywell, Inc., Minneapolis, Minn. Aerospace Div.
THE DESIGN AND BUILD OF A GAS BEARING GYROSCOPE POSSESSING HIGH G AND STERILIZATION CAPABILITY AND UTILIZING A LOW POWER GAS BEARING SPINMOTOR AND HIGH FREQUENCY PUMP Quarterly Progress Report, 1 Jan.–31 Mar. 1968
G. J. Erickson 31 Mar. 1968 20 p Prepared for JPL
(Contracts NAS7-100; JPL-951559)
(NASA-CR-94242; Rept.-20660-QR5) CFSTI: HC $3.00/MF $0.65 CSCL 17G

Work on the design, fabrication, and test of a gas bearing gyroscope possessing high g and sterilization capability and utilizing a low-power gas bearing spinmotor and high-frequency pump, has produced a gimbaled spinmotor, gyro assembly and first gyro test results. In parallel, a concentrated investigation into moisture, organic vapor, and particulate contamination is in process. Author

N68-21897*# California Univ., Berkeley. Space Sciences Lab.
INTERPLANETARY MAGNETIC FIELD IMP-1, MOTION PICTURE OF THE TRANSVERSE COMPONENTS
John M. Wilcox, Arthur Douglas Ritchie (Calif. Univ., Livermore), and Norman F. Ness (NASA. Goddard Space Flight Center) 22 Jan. 1968 10 p refs *Its* Ser. No. 9, Issue No. 5
(Grants NsG-243; NGR-05-003-230; NSF GA-1319; Contract Nonr-3656(26))
(NASA-CR-94232; AD-665987) CFSTI: HC $3.00/MF $0.65 CSCL 14E

A 16 mm movie representing the components normal to the Archimedes spiral direction of the interplanetary magnetic field observed by the IMP-1 satellite during December 1 - 14, 1963 is described. The movie displays in a unique way the dynamic character of these components of the field. It may be borrowed upon request to Dr. John M. Wilcox, Space Sciences Laboratory, University of California, Berkeley, California. Author (TAB)

N68-21911*# Honeywell, Inc., Minneapolis, Minn. Aerospace Div.
STERILIZABLE WIDE ANGLE GAS BEARING GYRO FGG334S Quarterly Progress Report, 1 Jan.–1 Apr. 1968
D. R. White 15 Apr. 1968 22 p Prepared for JPL
(Contract NAS7-100; JPL-951529)
(NASA-CR-94240; Rept.-20584-QR6; QPR-6) CFSTI: HC $3.00/MF $0.65 CSCL 17G

A progress report is presented on the sterilizable wide angle gas bearing gyro. Consideration is given to the moisture lockup problem in which an assymetrical journal pattern was shown to be the optimum pattern for preventing moisture lockup. Work conducted on the elimination of organic vapor and particulate contamination in the motor stator is described, and the analytical methods of pinpointing sources of contamination are discussed. These include infrared analysis, ultraviolet fluorescence analysis, mass spectroscopy, gas chromatography, and hot-stage microscopy. The specifications for vibration and testing of the spinmotors are delineated. B.S.D.

N68-21942*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A LIGHTING STRATEGY FOR LUNAR ORBITER MISSION DESIGN
Friedrich O. Huck Washington May 1968 38 p refs
(NASA-TN-D-4501) CFSTI: HC $3.00/MF $0.65 CSCL 14E

An analysis is presented which relates quality of lunar photographs to Lunar Orbiter trajectory. Furthermore, since several parameters which affect picture quality are uncertain, a strategy is developed which optimizes confidence levels in detecting specific lunar surface detail. This strategy is illustrated by examining Lunar Orbiter's capability to reveal small obstables in the form of right-circular cones which have lunar reflective properties. Results show that the smallest lunar detail can be detected at high phase angles (angle between incident light and camera) and long exposure times; however, the effects of variances in lunar reflectance, vehicle trajectory, and image smear result in higher levels of confidence in the detection of larger detail at lower phase angles and shorter film exposures. Author

N68-21986# Royal Aircraft Establishment, Farnborough (England).
THE EFFECTS OF CLEANING A LANGMUIR PROBE
T. G. Wills Feb. 1967 41 p refs
(RAE-TR-67037) CFSTI: HC $3.00/MF $0.65

A method of cleaning a Langmuir probe by electron bombardment heating is described. The ability to maintain the probe at a known high temperature implies an ability to control its state of cleanliness, contact potential etc. This control is essential to the reliable diagnosis of gaseous plasmas. Details are given of a circuit which produces rapid Langmuir characteristics of a discharge in argon. The method of analysis is that of Allen, Boyd and Reynolds (1957) and F.F. Chen (1964). Using three different probe materials, it was found that heating the probe from 300 to 1700°K produced a variation in measured electron temperature of 15% and in plasma density of 100%. It is suggested that not all of this variation is attributable to probe contamination. Secondary effects which may be related to probe temperature are briefly mentioned. Author (ESRO)

N68-22035*# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
A METHOD FOR PHOTOGRAPHING MICROWAVE WITH A POLAROID FILM Interim Technical Report
Keigo Iizuka Mar. 1968 26 p
(Grant NGR-22-007-056; Contract N00014-67-A-0298-0005)
(NASA-CR-94305; TR-558) CFSTI: HC $3.00/MF $0.65 CSCL 14E

A regular Polaroid film has proved to be applicable to a quick and easy direct mapping of an electromagnetic field. The method utilizes the selective development of the film in accordance with the thermal image produced by the electromagnetic field. The power required for the creation of a clear image is about 0.06 watts per square inch. The time of exposure to the microwave is about 15 to 60 seconds. The method would be most useful for preparing microwave holograms. It can also be applied to the mapping of the temperature distribution in space. Author

N68-22047 Moog Servocontrols, Inc., East Aurora, N. Y.
POTENTIOMETER EVALUATION TEST REPORT. MOOG PART NUMBER 062-45442 (COMPUTER INSTRUMENT CORPORATION) FOR S-IC THRUST VECTOR CONTROL SERVOACTUATOR
E. G. Siebold 5 Apr. 1967 47 p refs
(MR-1182)

Test results on three infinite resolution, dual element, rectilinear potentiometers for the Saturn V servoactuator program are presented. Two of the specimens were subjected to dynamic or operating type tests, the other specimen went through non-operating chamber tests. Intermittent electrical noise in excess of 300 ohms was observed on all three specimens. Disassembly and inspection of the units revealed internal contamination by teflon, rubber, and metal particles as sources of excessive electrical noise. G.G.

N68-22048 Moog Servocontrols, Inc., East Aurora, N. Y.
POTENTIOMETER EVALUATION TEST REPORT. MOOG PART NUMBER 062-45442 (MARKITE CORPORATION) FOR S-IC THRUST VECTOR CONTROL SERVOACTUATOR
E. G. Siebold 5 Apr. 1967 46 p refs
(MR-1183)

Evaluation test results on infinite resolution, dual element, rectilinear potentiometers for the Saturn thrust vector control servoactuator mechanisms are discussed. The units were subjected to a total of 480,000 cycles prior to the final performance test. Electrical noise readings were recorded during the final performance test and are presented in table form. After removal of oilite bearing material deposited on the shafts during life cycling, electrical noise disappeared in subsequent final performance tests. G.G.

N68-22089 Moog Servocontrols, Inc., East Aurora, N. Y.
POTENTIOMETER EVALUATION TEST REPORT. MOOG PART NUMBER 062-45411 (SERVONIC INSTRUMENT INC.) FOR S-2, S-4B THRUST VECTOR CONTROL SERVOACTUATORS

E. G. Siebold 28 Jul. 1967 30 p refs
(MR-1218)

Evaluation tests results on two wire wound, dual element, rectilinear potentiometers for the Saturn V servoactuator program are reported. These potentiometers are filled to about 80% of their internal volumes with hydraulic fluid to eliminate electrical noise. Some oil leakage was observed from the rod seals on both units during life cycling and out-of-tolerance electrical noise was also recorded during post vibration performance tests. G.G.

N68-22106 Virginia Univ., Charlottesville.

AN ANNULAR LITHIUM-DRIFTED GERMANIUM DETECTOR FOR STUDYING NUCLEAR REACTION GAMMA-RAYS

Arthur James Levy (Ph.D. Thesis) 1966 223 p
Available from Univ. Microfilms: HC $10.15/MF $3.00 Order No. 67-3755

Lithium drifted germanium gamma detectors were fabricated in the form of 1" long annular cylinders with a 3/16" diameter coaxial hole. Fabrication techniques and testing procedures for the detectors are detailed. The efficiencies of these annuli were measured at energies from 0.5 to 9 MeV. One such Ge(Li) annulus was used as the center crystal of a three-crystal spectrometer to study the Mg^{24} gamma decay following the $Na^{23}(d,n)Mg^{24}$ reaction. The deuteron bombarding energy was 0.990 MeV. Of the 64 observed transitions attributed to the decay of Mg^{24}, 35 of these are unreported in the literature. 103 additional transitions remain unidentified. The Mg^{24} states at 9.5 MeV $(4^+, 6^+)$ and 8.44 MeV are observed to be doublets. The energies of these doublets measured in the present work are 9528±3 keV, 9408±7 keV and 8437±4 keV, 8424±3 keV. Dissert. Abstr.

N68-22110 Hewlett-Packard Co., Palo Alto, Calif.

WHAT IS SIGNAL AVERAGING?

Charles R. Trimble Apr. 1968 16 p *Its* Hewlett-Packard J., Vol. 19, No. 8

Described is the development and performance of a signal averaging instrument that takes advantage of redundant information provided by repetition to pull out repetitive waveforms buried in noise. The apparatus samples input signals at fixed time intervals, converts the samples to digital form, and stores sampled values at separate locations in a memory for later summation. The averager's comb-filter behavior leaves the noise power remaining in the averaged waveform as the sum of the powers contained in each comb tooth when the desired signal and the noise are in the same frequency range. Instrument noise limits the maximum output signal-to-noise ratio to about 57 dB. Two plug-ins for this new digital signal analyzer and novel averaging algorithms provide a stable, calibrated display of the average at all times and allow the averager to follow slowly changing signals. An input–output coupler provides off-line processing of the averaged data stored in the analyzer's memory; for complex processing, the coupler interfaces the analyzer with a general purpose digital computer. G.G.

N68-22125# Aerospace Corp., El Segundo, Calif. Lab. Operations.

THE SAN FERNANDO OBSERVATORY

E. B. Mayfield, D. Vrabec, E. H. Rogers, T. J. Janssens, and R. A. Becker Feb. 1968 26 p refs
(ATR-68(8102)-4)

Operating characteristics are presented on the 61-cm (24-in.) vacuum telescope and spectroheliograph. This instrument, to be used for studying strong solar magnetic fields, will obtain simultaneous spectroheliograms on 70-mm film using the circularly polarized components of selected Fraunhofer lines to yield the longitudinal component of the field. Also discussed are two 15-cm (6-in.) objective telescopes used for $H\alpha$ and white light studies. The first uses a 0.25-Å Zeiss filter that can be tuned ±16 Å on either side of $H\alpha$. It is used with a 3-in.-diam solar image scale and a 35-mm motion picture camera. Both axes are guided. Automatically controlled programming and exposure permit time-lapse photography through the entire $H\alpha$ line. The second telescope uses a 300-Å filter centered in the green to obtain whole-disk photographs at time intervals of approximately 1 min. Author

N68-22172 Stanford Univ., Calif.

A STUDY OF THE STRUCTURE OF SPARK COLUMNS FOR VELOCITY MEASUREMENT IN A HYPERSONIC STREAM

James Burley Kyser (Ph.D. Thesis) 1966 166 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-4389

The experimental part of the study consisted of (1) time-resolved measurements of spark current, temperature, and intensity profile made in a static test chamber over a range of spark energies and ambient static pressures, with nitrogen as the test gas, and (2) measurement of flow velocity in a hypersonic stream made under controlled conditions. The spark process was also studied analytically on the basis of published data from electron-drift experiments conducted in nitrogen. The measured time-resolved spark current is used as an input in the analysis, and it is shown that good agreement between measured and computed rates of change of temperature is obtained when the computed intensity profile is matched to the measured intensity profile. The analysis also shows that the rapid recombination of ions and electrons, characteristic of nitrogen plasmas, can impose a serious limit to the accuracy of any technique relying on the detection of the residual ionization in a spark-heated column. Dissert. Abstr.

N68-22228# Environmental Science Service Administration, Atlantic City, N. J. Weather Bureau.

EVALUATION OF SEVERAL MULTI-TRANSMISSOMETER SYSTEMS Interim Report

Ernest E. Schlatter Dec. 1967 111 p refs Prepared for FAA
(RD-67-72)

A test program has been developed and implemented to evaluate multitransmissometer systems. These consist primarily of instruments at touchdown, midpoint, and rollout locations at five airfields distributed across the continent in differing climatic regimes. The airfields are located at Atlantic City, N. J., New York City, N. Y., Chicago, Ill., Denver, Colo., and Los Angeles, Calif. The data acquisition technique and program are described. Partial analysis of available data indicates that no single transmissometer will always be most representative of lowest visibility conditions at any airport and even with three systems along the runway unreported variations in RVR will still occur. Analysis of 55-, 45-, and 15-second sampling intervals for RVR computation shows little difference between 55- and 45-second sampling. The number and magnitude of differences increase when RVR from a 15-second sampling is compared to RVR from a 55-second sampling especially during rapid changes in transmittance. Author

N68-22290*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FLIGHT INVESTIGATION OF CAPACITANCE-TYPE METEOROID DETECTOR USING AN INFLATABLE PARAGLIDER

James H. Siviter, Jr. Washington May 1968 42 p refs
(NASA-TN-D-4530) CFSTI: HC $3.00/MF $0.65 CSCL 14B

One of the meteoroid-detection systems under development consists of thin-film multiple capacitors made of layers of aluminized polyethylene terephthalate (PET). The capacitor momentarily discharges when penetrated by a hypervelocity projectile. The multilayer capacitor-type detector used in this experiment was designed to detect particle penetrations in 6.5, 20, and 45 microns of PET. Eighteen square meters of the micrometeoroid-detector material was attached to the wing of an inflatable paraglider. The paraglider provided a convenient mounting structure for the sensors and a means of recovering the sensors after the flight test. The

packaged paraglider and sensors were boosted to an altitude of 93 kilometers where the paraglider was ejected and inflated. The inflated paraglider then continued along a ballistic trajectory to a maximum altitude of 154.7 kilometers. Sensor data were recorded for approximately 169 seconds at altitudes above 121 kilometers. The excessive noise on the telemetry-data channels made exact analysis of the penetration data inconclusive. The deployment and inflation of the paraglider were normal and it attained the proper flight attitude during reentry; however, the telemeter section failed to release, and, as a result, the reentry loads were excessive.
Author

N68-22305*# National Aeronautics and Space Administration, Washington, D. C.
MEDIA REQUIREMENTS FOR GENERAL AVIATION
Charles H. Gould and Roger L. Winblade *In its* Recent Advan. in Display Media 1968 p 23–24 (See N68-22302 12-09)

Enlarged engine power and payloads together with increased cruise speed and range increase the probability of encountering poor weather and thus put a higher workload on the pilots of modern aircraft. Pilot capacity can be approved by installing display media and hardware that offer relief from overload. Digital computer-driven integrated display devices provide computations for the routine flight management of complete and dual navigation equipment as well as for simpler aviation technologies. G.G.

N68-22331*# Army Map Service, Washington, D. C.
EXPERIMENTAL MAPPING FROM RANGER PHOTOGRAPHY Final Report
Aug. 1966 216 p refs
(NASA Order T-43327(G))
(NASA-CR-92080) CFSTI: HC$3.00/MF$0.65 CSCL 08B

Modifications in the conventional photogrammetric mapping procedures and equipment are described. It is concluded that: (1) It is possible to obtain hypsometric data by stereophotogrammetric methods from photography having an extremely small parallactic angle, and the minimum precision for a single z-observation ranges from 0.01 mm to 0.09 mm. (2) Specially modified first-order analog and analytical stereoplotters afford the most efficient means for expedient map production from stereoscopic pairs having nonstandard geometric qualities. (3) Analytical topographic compilation is technically feasible, and provides a method of utilizing photography that cannot be accommodated on standard-type or modified analog instruments. (4) These approaches are the solution to the prime objective of developing optimum methods for the reduction of Orbiter photography. (5) The approaches used for the Ranger photography provide the most practical means for the production of lunar topographic maps from unconventional photography. Author

N68-22345*# Honeywell, Inc., Minneapolis, Minn. Aerospace Div.
STERILIZABLE WIDE ANGLE GAS BEARING GYRO FGG334-S Quarterly Progress Report, 1 Oct. 1967–1 Jan. 1968
R. S. Johnson and G. J. Erickson 15 Jan. 1968 16 p Prepared for JPL
(Contracts NAS7-100; JPL-951529)
(NASA-CR-94327; Rept.-20584-QR5; QPR-5) CFSTI: HC $3.00/MF $0.65 CSCL 13G

Some technical problems of the wide angle gyro and how they were solved are discussed. The lockup problem, which is the inability to restart the motor when it was stopped after continuous running for periods between 10 and 100 hours, is solved by using patterns which pump gas through the bearing assembly. Three venting methods were used to pump gas through the assembly of thrust and journal bearings, thus carrying moisture away faster than it could condense. Two successful journal venting methods were examined. Center venting which prevented lockup but reduced the g-capability to an inadequate level, and asymmetrical pattern, which prevented lockup but reduced g-capability to a lesser extent than center venting. A new thrust bearing pattern which increases the g-capability at high frequencies was examined for solving the problem of g-capability reduction. The testing of the thrust pattern is described, and figures are drawn to show the increase in thrust g-capability. B.S.D.

N68-22379 Royal Radar Establishment, Malvern (England).
A CONTACTLESS INSTRUMENT FOR MEASURING THE SPEED OF MOVING METAL
V. G. Kotova 1966 8 p Transl. into ENGLISH from Mech. and Automation of Production (Kiev), no. 8, 1966 p 21–23
(RRE-TRANS-170) CFSTI: $3.00

A pulsed system for contactless measurement of the speed of moving metal has been developed. The instrument design is based on a method of correlation of two similar random signals which result from variation in the reflection coefficient along the surface of the rolled metal and which are out of phase by a time shift. The speed is determined by the time for the metal to pass between two light gratings, projected on to its surface with a fixed spacing between them. Author

N68-22383*# Techtran Corp., Glen Burnie, Md.
STUDY OF THERMOCOUPLES FOR MEASUREMENT OF HIGH TEMPERATURES [ETUDE DE THERMOCOUPLES POUR LE REPERAGE DES HAUTES TEMPERATURES]
Michel Villamayor (Ph.D. Thesis) Washington NASA Apr. 1968 84 p refs Transl. into ENGLISH of CEA-R-3182 Rept.
(Contract NASw-1695)
(NASA-TT-F-11623) CFSTI: HC$3.00/MF$0.65 CSCL 20M

Previous works have shown that tungsten-rhenium alloy thermocouples were a good instrument for measuring high temperatures. Starting with that fact the author has studied the W/W 26% Re and W 5% Re/W26% Re thermocouples of French manufacture intended for measuring temperatures up to 2300°C. In experiments outside the reactor he has determined the general characteristics of these thermocouples—average calibration curves, thermal shock influence, response times, and alloys which permit cold source compensation. The evolution of these thermocouples under thermal neutron flux has been determined by experiments in the reactor. The observations have led the author to propose a new type of thermocouple made of molybdenum–columbium alloys.
Author

N68-22393# National Bureau of Standards, Washington, D. C.
DEVELOPMENT AND ANALYSIS OF TECHNIQUES FOR CALIBRATION OF KERR CELL PULSE-VOLTAGE MEASURING SYSTEMS
Esther C. Cassidy and H. N. Cones Sep. 1967 46 p refs
Prepared by Sandia Corp.
(Contract AT(29-1)-789)
(SC-CR-67-2751) CFSTI: HC$3.00/MF$0.65

Two methods of calibration were developed and evaluated for a Kerr cell pulse voltage measuring system. An attempt was made to achieve calibration without reference to conventional pulse divider techniques. Pulse measurements using a Kerr cell (interplate distance = 0.25 cm) calibrated by these methods showed that the Kerr cell results were accurate at least to the same degree as calibrated divider results, the difference between the two being less than 1%. However, results obtained with a cell of greater interplate spacing (0.75 cm) differed considerably (by up to 6%) from simultaneous divider results. A nonuniform field distribution between the plates was found to be the principal source of error, and a technique of correcting for the complications added by the nonuniform field was devised. Measurements after correction agreed with the calibrated divider results to within 1.5% NSA

N68-22409# California Univ., Berkeley. Lawrence Radiation Lab.
THE RAPID MAPPER: A DATA-ACQUISITION SYSTEM FOR LARGE-SCALE MAGNETIC FIELD MEASUREMENTS
Frederick W. Macondray 5 Jul. 1967 20 p Presented at 2d Intern. Conf. on Magnet Technol., Oxford, 11–14 Jul. 1967
(Contract W-7405-ENG-48)
(UCRL-17642; CONF-670705-18) CFSTI: HC $3.00/MF $0.65

An automated measuring system, called the Rapid Mapper, was built in 1962 and rebuilt in 1964 for large-scale digital magnetic-field mapping. This machine is designed to perform a variety of automatic and semi-manual dc measurements. In the automatic modes the machine positions a probe, sequences the measurements, and records the data for later computer analysis. The semi-manual modes are used when computer analysis of manual data is desired. A third-generation Rapid Mapper, which is now in the planning stage, will be controlled by a small digital computer. It will contain all the capabilities of the preceding machines. In addition it will make digital pulsed field measurements and do error checking at the time of measurement. The use of a computer will greatly facilitate modification of test programs. Discussed are organization of the system, probe positioning, and flow diagrams of the control logic. Author (NSA)

N68-22413# California Univ., Berkeley. Lawrence Radiation Lab.
THE "SQUARE LOOP" FLUX STANDARD: A PRECISION PULSE GENERATOR
Frederick W. Macondray 23 Jun. 1967 13 p refs Presented at 2d Intern. Conf. on Magnet Technol., Oxford, 11–14 Jul. 1967
(Contract W-7405-ENG-48)
(UCRL-17639; CONF-670705-17) CFSTI: HC $3.00/MF $0.65

A square-loop flux standard is a simple and reliable device for calibrating a search coil and integrator magnetic-field-measuring system. A reproducible $\int V \cdot dt$ pulse is generated by reversing the magnetization of a temperature-controlled, temperature-compensated, toroidal-core transformer. The core is a Ni–Fe alloy with a square hysteresis loop. Output pulses in the range 0.01 to 1.0 volt-second (10^6 to 10^8 maxwell-turns) can be selected. Accuracies of 0.03% and better are achieved with relatively simple circuits. Subjects discussed include typical uses, operation of the basic device, temperature compensation of the toroid, performance history, and design example. Author (NSA)

N68-22450# California Univ., Berkeley. Lawrence Radiation Lab.
DEVELOPMENT OF A HIGH PRESSURE MASS SPECTROMETERIC GAS ANALYSIS SYSTEM
William W. Waddel (M.S. Thesis) Dec. 1967 41 p refs
(Contract W-7405-ENG-48)
(UCRL-17866) CFSTI: HC $3.00/MF $0.65

A relatively high pressure gas analysis system utilizing a quadrupole mass spectrometer was developed. The gas to be sampled is contained at pressures up to 20 torr in an inlet tube from which a molecular beam issues through a small orifice. The molecular beam is collimated and directed through the ionizer of the spectrometer. By employing differential pumping, a modulated molecular beam, and a narrow band phase sensitive lock-in amplifier, a partial pressure of 9×10^{-13} torr was detected in a beam with an equivalent pressure of 6×10^{-7} torr (1.5 ppM). Based on the signal-to-noise ratio it was estimated that the minimum partial pressure that could be detected in this beam is about 6×10^{-14} torr (0.1 ppM). Two different types of noise averaging devices were employed, a narrow band lock-in amplifier and an analog-to-digital computer. The molecular isotopes of oxygen were studied to determine the sensitivity of the system. Known mixtures of methane in hydrogen were also analyzed and the cracking pattern of these species is reported. Author (NSA)

N68-22454*# Control Data Corp., Minneapolis, Minn. Aerospace Research Dept.
THE AUTOMATION OF A STELLAR PROPER MOTION MEASURING SYSTEM Annual Report, 1 Jul. 1966–30 Jun. 1967
James S. Newcomb, Walter Gysling, Robert D. Willey, and George E. Zenk 30 Jun. 1967 123 p refs Prepared for Minn. Univ., Minneapolis
(Grant NSR-24-005-062)
(NASA-CR-94336; AR-2) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Described are the mechanical design, the design of the operator aids and the displays, and the design of the data acquisition and control logic. These subsystems form the controlling and connecting link between the microdensitometer which scans the photographic star plate and the digital magnetic tape which receives the measurements for subsequent analysis by a super-scale high speed computer. Instruments described in the operator aids include CRT display of the star images being scanned, CRT presentation of image detection threshold levels, and motor controllers which are free of rfi. The logic section describes the control and paths of data flow through a small semiconductor very high speed memory and through a high speed core memory which together form a data buffer between the microdensitometer and the magnetic tape. The arrangement of data in a format making efficient use of the buffer, tape, and computer capabilities is described, as well as the spot position interpolator from a 25 megacycle clock. Author

N68-22464 Moog Servocontrols, Inc., East Aurora, N. Y.
POTENTIOMETER EVALUATION TEST REPORT. MOOG PART NUMBER 062-45512 (COMPUTER INSTRUMENTS CORPORATION) FOR S-IB THRUST VECTOR CONTROL SERVOACTUATOR
E. G. Siebold 29 Feb. 1968 28 p refs
(MR-1289)

A test program designed to evaluate alternate potentiometer sources for the Saturn S-IB thrust vector control servoactuator is reported. Three potentiometers were tested: infinite resolution, dual element, and rectilinear. Results obtained from performance, random vibration, and temperature tests are reported. S.C.W.

N68-22465 Moog Servocontrols, Inc., East Aurora, N. Y.
POTENTIOMETER EVALUATION TEST REPORT. MOOG PART NUMBER 062-45411 (COMPUTER INSTRUMENTS CORPORATION) FOR S-2, S-4 B THRUST VECTOR CONTROL SERVOACTUATORS
E. G. Siebold 29 Feb. 1968 19 p refs
(MR-1288)

A test program designed to evaluate alternate potentiometer sources for the Saturn S-2 and Saturn S-4B thrust vector control servoactuator is reported. Three potentiometers were tested: infinite resolution, dual element, and rectilinear. Results obtained from performance tests, and immersion (temperature) tests are reported. S.C.W.

N68-22467*# Eastman Kodak Co., Rochester, N. Y. Apparatus and Optical Div.
LUNAR PHOTO STUDY, PHASE 2 Final Report, 1 Nov. 1965–1 Nov. 1966
Edgar D. Seymour and George T. Keeve 1 Nov. 1966 248 p refs
(Contract NAS9-3826)
(NASA-CR-92076; Z3841) CFSTI: HC $3.00/MF $0.65 CSCL 14E

Summarized are results of a lunar photo study of simulated lunar surfaces in which the following are considered: (1) contour mapping by photoclinometry; detection and enhancement of lunar photo details; and methods of rating lunar picture quality. S.C.W.

N68-22469 Moog Servocontrols, Inc., East Aurora, N. Y.
POTENTIOMETER EVALUATION TEST REPORT. MOOG PART NUMBER 062-45442 (SERVONIC INSTRUMENT INC.) FOR S-IC THRUST VECTOR CONTROL SERVOACTUATOR
E. G. Siebold 28 Jul. 1967 42 p refs
(MR-1196)

A test program designed to evaluate alternate potentiometer sources for the Saturn 1C thrust vector control servoactuator is reported. Three potentiometers were tested: wire wound, dual element, and rectilinear. Results obtained from the following tests are reported: performance tests; vibration tests; voltage rating test; life cycling tests; shock tests; ambient temperature tests; field storage tests; humidity tests; and salt spray tests. S.C.W.

N68-22566# California Univ., Livermore. Lawrence Radiation Lab.
HAZARDS CONTROL Progress Report, May–Aug. 1967
Aug. 1967 30 p refs
(Contract W-7405-ENG-48)
(UCRL-50007-67-2; PR-28) CFSTI: HC$3.00/MF$0.65

The development of various radiation detector systems and associated research for health safety is reported. Topics discussed include a readout system for thermoluminescent dosimeters, design of a flowcounter for krypton-85 in natural gas, gamma dosimetry of plutonium-238–beryllium neutron source, tritium-in-air generator for calibrating tritium monitors, radiation source–detector geometry, development of portable air sampler, safety modifications of a spark-generating device, and testing of ventilation ductwork and hood coating materials. NSA

N68-22601# United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center.
CARBON METER FOR SODIUM Quarterly Progress Report, 1 Jul.–30 Sep. 1966
15 Mar. 1967 28 p
(Contract AT(30-1)-3665)
(UNC-5172)

Thirty-two probe tests were completed in static high-C Na. Substitution of water vapor H_2–Ar_2 mixtures for pure H_2 as the probe gas greatly increased the C flux through the probe wall, eliminated carbon buildup in the wall, and reduced the H_2 permeation rate into the Na. Quantitative catalytic conversion of the CO formed in the probe gas to CH_4 was shown to be feasible, permitting use of the highly sensitive flame ionization detector to measure continuously the C flux through the probe wall. Results indicate that the C meter probe will be pure Fe, ≈10-mils thick, operated at ≈1400°F. Author (NSA)

N68-22612# Commissariat a l'Energie Atomique, Saclay (France).
MEASURING SYSTEM FOR ACTIVE GASES USING TWO PROPORTIONAL COUNTERS [BANC DE MESURE DE GAZ ACTIFS A DEUX COMPTEURS PROPORTIONNELS]
Jean Colomer Dec. 1967 40 p refs In FRENCH
(CEA-R-3403) CFSTI: HC$3.00/MF$0.65

Equipment is described for measuring β-emitting radioactive gases (^{3}H, ^{85}Kr) of low activity. The counters have metallic cases and operate proportionally with an 8 db amplifier to assure maximum sensitivity; efficiency for ^{3}H is close to 100%. Minimum background noise is achieved by combining two types of protection: absorption of cosmic and ambient radiation by Pb, and an eight-compartment sheath enclosing each counter. Optimum operating conditions were experimentally determined by studying: (1) CH_4-H_2, CH_4-He, and CH_4-A mixtures as filling gases; (2) effects of CH_4 filling pressure; and (3) methods of mixing active and counting gas. The background noise of the whole system is 0.035 cpm/cm^3 or 0.018 cpm/cm^2 of cathode, thus giving a detection limit of about 6×10^{-8} μc/cm^3. The characteristics of the counters in current use are: effective volume, long counter 135 cm^3, short counter 67 cm^3, ±0.05%; plateau, length 600 to 800 V, slope ≤0.5%/100 V, medium at 3200 V with CH_4 at 760 torr. K.W.

N68-22625# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
CASCADE AND THREE-STAGE MASS SPECTROMETER VACUUM SYSTEMS
J. A. McHugh and J. C. Sheffield 20 Oct. 1967 20 p refs
(Contract W-31-109-ENG-52)
(KAPL-3382) CFSTI: HC$3.00/MF$0.65

A completely new vacuum system of the cascade mass spectrometer and the modifications made to the vacuum system of the three-stage spectrometer are described. Both systems are now bakeable and of all-metal construction, and both systems employ well trapped mercury vapor pumps. Author (NSA)

N68-22632# California Univ., Berkeley. Lawrence Radiation Lab.
ESR SPECTROMETER FOR GASEOUS MEDIA. PART 1: PRELIMINARY DESIGN
Kenneth W. Lamers Oct. 1967 65 p refs
(Contract W-7405-ENG-48)
(UCRL-17306, Pt. 1) CFSTI: HC$3.00/MF$0.65

The spectrometer described here is designed to measure the rate of change of very small concentrations of hydrogen atoms. It has not yet been tested with regard to the design objective, so the design philosophy, operating procedures, and electronic performance only are described. The spectrometer is designed to recover absorption spectra directly, as opposed to the customary derivative. The cavity resonator (1420 MHz) is connected in a transmission scheme that uses barretter detection. The field modulation frequency is 280 Hz; the magnetic field strength is approximately 2 gauss. Author (NSA)

N68-22644# California Univ., Livermore. Lawrence Radiation Lab.
SENSITIVITY OF SOLID STATE DETECTORS TO FLUORESCENT X-RAYS
P. J. Ebert and H. N. Kornblum 7 Jun. 1967 9 p
(Contract W-7405-ENG-48)
(UCID-15277) CFSTI: HC$3.00/MF$0.65

Preliminary results of calibration of 125- and 250-μ thick silicon detectors using a PAR Model HR-8 Lock in Amplifier for signal enhancement are presented. NSA

N68-22645* LTV Aerospace Corp., Dallas, Tex. Missiles and Space Div.
INSTRUMENTATION TO DETERMINE AND IMPROVE SCOUT VEHICLE VERTICAL AND ROLL ALIGNMENT Final Report
K. Cejka and R. R. Priest 9 Oct. 1967 257 p
(Contract NAS1-5592; Proj. Scout)
(NASA-CR-66609; Rept.-23.342) CFSTI: $3.00 CSCL 22B

A requirement was established to develop an improved system of aligning the Scout vehicle in the yaw and pitch planes and about the roll axis. Study and development activities culminated in an actual demonstration of flight equipment and associated ground support equipment on Scout Vehicle S-159 both in-plant and in the field. The equipment is described and the demonstration procedures with demonstration results are included. The vehicle instrumentation and the ground support equipment were successfully demonstrated and the results were as follows: (1) The Scout vehicle can be aligned vertically to within 1 arc sec. using a verticality sensor mounted in lower D section. (2) The Scout vehicle can be positioned in roll (azimuth) by using an optical link consisting of a theodolite, a porro prism mounted on lower D section, and a target mounted on the theodolite. (3) The launch azimuth indicating system was very repeatable and had an appropriate sensitivity level. Author

N68-22656# Atomic Energy Commission, Washington, D. C.
DEVELOPMENT OF AN IN-CORE VOID METER
Masahiro Satomi, Hideo Yusa, Akira Oda, Takeo Uga, and Keiichi Mochizuki 1967 17 p refs Transl. into ENGLISH from Keisoku to Seigyo (Japan), v. 3, no. 3, Sep. 1967 p 69–75
(AEC-TR-6929) CFSTI: HC$3.00/MF$0.65

Two types of electronic void meters, a solenoid type and a digital type, with high sensitivity and the ability to withstand high temperatures, high pressures, and high radiation fields are described. They have been used in the JPDR to measure void fractions in the upper section of the chimney and the downcomer outlet. The principle and construction of the void meters, detector circuits, and measurement results are presented. NSA

N68-22657# Argonne National Lab., Ill.
ION-RETARDING LENS TO IMPROVE THE ABUNDANCE SENSITIVITY OF TANDEM MASS SPECTROMETERS
Kurt A. Kaiser and Charles M. Stevens Nov. 1967 10 p refs
(Contract W-31-109-ENG-38)
(ANL-7393) CFSTI: HC$3.00/MF$0.65

The design, construction, and performance of a retarding lens used to increase the abundance sensitivity of tandem magnetic-analyzer mass spectrometers are described. Under typical operating conditions in a 30-cm-radius, two-state system, the abundance sensitivity improved by a factor of about 10 on the high-mass side and about 10^3 on the low-mass side. Author (NSA)

N68-22662# United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center.
CARBON METER FOR SODIUM Quarterly Progress Report, 1 Oct.–31 Dec. 1966
W. Caplinger, C. Gregg, M. Kolodney, S. Lukasik, J. McKee et al 15 Jun. 1967 44 p ref
(Contract AT(30-1)-3665)
(UNC-5180) CFSTI: HC$3.00/MF$0.65

The carbon meter response to insertion and removal of carburized iron tabs in a sodium thermal convection loop was measured. A flame ionization detector was selected, evaluated, and found to be satisfactory for the C meter gas analysis system with slight modification. A standard probe gas composition of 0.5% water vapor, 5% H_2, balance Ar was selected on the basis of additional static pot tests. Considerable evidence was developed indicating that H_2 reacts with active C in Na at 1400°F to form hydrocarbons and thereby depresses the C activity. One probe was examined after 1446 hr of operation in high C Na at 1400°F. Author (NSA)

N68-22673# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
INSTRUMENTATION FOR DYNAMIC MEASUREMENTS OF RESISTANCE WELDING CURRENT AND ELECTRODE FORCE
B. B. Bowden, J. A. Hoskins, R. D. Quinnell, D. G. Scott, and P. W. Turner 23 Jan. 1968 23 p refs
(Contract W-7405-ENG-26)
(Y-1580) CFSTI: HC$3.00/MF$0.65

Instrumentation has been designed that can dynamically determine the current and electrode-force changes during a resistance welding cycle. Since the information obtained can be recorded and studied, resistance welds can be more accurately reproduced. Author (NSA)

N68-22678# Commissariat a l'Energie Atomique, Saclay (France).
ENERGY LOSS, RANGE AND STOPPING POWER OF CHARGED PARTICLES IN SILICIUM OR GERMANIUM DETECTORS [PERTE D'ENERGIE, PARCOURS ET RALENTISSEMENT DES PARTICULES CHARGEES DANS LES DETECTEURS AU SILICIUM OU AU GERMANIUM]
Jean Picard and Gerard Souchere Oct. 1967 24 p refs In FRENCH
(CEA-R-3371) CFSTI: HC$3.00/MF$0.65

Energy loss, range, and stopping power of charged particles in silicon and germanium solid state detectors are presented in graph and table forms. Author

N68-22688# Rensselaer Polytechnic Inst., Troy, N. Y.
INSTRUMENTATION DEVELOPMENT Annual Technical Report, 1 Jul. 1966–30 Sep. 1967
30 Sep. 1967 193 p refs
(Contract AT(30-3)-328)
(RPI-328-100) CFSTI: HC$3.00/MF$0.65

The status of the communications link between Rensselaer Polytechnic Institute and the CDC-6600 at New York University is outlined. Improvement of the Rensselaer linac by addition of a new accelerator section and the description of a new multiple drift tube installation for multiple-flight-path experiments are briefly discussed. NSA

N68-22693# Royal Radar Establishment, Malvern (England).
LARGE-AREA, PYRO-ELECTRIC, RADIATION RECEIVER
L. S. Kremenchugskii, A. F. Mal'nev, and V. V. Samoilov [1966] 8 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim., (Moscow), pt. 6, 1966 p 169–171
(RRE-TRANS-172; TIL/OT/8695) CFSTI: $3.00

Rapid-acting, broad-area, pyroelectric heat-radiation receivers with a threshold $(2-5)\times 10^{-9}$ watts/Hz$^{1/2}$ and a time-constant ≈ 50 μS. are described. Their zonal sensitivity (i.e. how the sensitivity varies over the area) is investigated. Author

N68-22697# Oak Ridge National Lab., Tenn.
MSRE DESIGN AND OPERATIONS REPORT. PART 2A: NUCLEAR AND PROCESS INSTRUMENTATION
J. R. Tallackson Feb. 1968 397 p ref
(Contract W-7405-ENG-26)
(ORNL-TM-729, Pt. 2A) CFSTI: HC$3.00/MF$0.65

The considerations which influenced the MSRE Instrumentation and Control System design, particularly those which are unique or are peculiar to the MSRE, are discussed. The physical layout of the instrumentation system is described. A general description of the overall layout is given, and each area is described separately. The instrument systems are located by area, and the routing and installation of their interconnections are included. A broad, all-inclusive picture of the entire MSRE instrumentation and control system, including control of auxiliary equipment and the instrument power system, is given. The "mode control" used to guide reactor operation is discussed with diagrams which define the conditions for the various modes (prefill, operate-start, operate-run). The safety-grade instrumentation and controls associated with the MSRE safety system are discussed. The discussion includes general design criteria illustrated by a typical system. Author (NSA)

N68-22703*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SOLID STATE DETECTOR EXPERIMENT FOR ELECTRON MEASUREMENTS ON OGO-F
James H. Trainor and Donald J. Williams [1968] 16 p refs
(NASA-TM-X-63195; X-611-68-119) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A solid state detector system is described which has been developed for flight on an orbiting geophysical observatory in polar orbit. Measurements will be made of the electron flux and spectra above 35 keV, both for precipitating and locally mirroring electrons, as well as atmospheric backscatter. This paper reviews the physical need and the design requirement of such an experiment; and describes the detector and electronic implementation of the experiment including the methods of monitoring detector and electronic performance in flight. Author

N68-22716# Commissariat a l'Energie Atomique, Saclay (France).

BEHAVIOUR OF BF_3 COUNTERS AFTER IN-PILE IRRADIATION [COMPORTEMENT DE COMPTEURS A BF_3 APRES IRRADIATION DANS UN REACTEUR]

Robert Verdant Dec. 1967 30 p refs In FRENCH
(CEA-R-3343) CFSTI: $3.00

The behavior of a proportional BF_3 counter with aluminum cathode was studied after irradiation from 10^5 to 10^6 n. cm^{-2} in the swimming-pool reactor Triton. The pulse spectrum was only slightly modified by two successive irradiations at 10^{15} n. cm^{-2}, and 1 hour after the end of the irradiation the decrease in sensitivity reached 10 to 20 percent. One hour after irradiation at 10^{16} n. cm^{-2} this decrease was 20 percent but the pulse spectrum was affected. The advantages of an aluminum cathode with respect to a standard counter using a copper cathode and irradiated under the same conditions are given. Beforehand, it had been established that the limit for use of an aluminum-cathode counter in the presence of γ radiation is about 200 R.h^{-1}. Author

N68-22724# Commissariat a l'Energie Atomique, Saclay (France).

OIL-LEAK DETECTOR [DETECTEUR DE FUITE D'HUILE]

David da Costa Viera, Pierre Fierard, Louis Bacchiani, and Noel Lions Dec. 1967 34 p refs In FRENCH
(CEA-R-3322) CFSTI: $3.00

This apparatus is designed to set off an alarm when the oil level in a reservoir exceeds or falls short of a given value. The detection system consists of a condenser whose plates are separated by air or by oil, the condenser being immersed or nonimmersed. A very small change in capacity (of the order of 1 pF for a height of oil of 1 cm) should be detected with respect to the high capacity of the connecting cable. Author

N68-22744# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

A SURVEY METER FOR THE MEASUREMENT OF INTENSE γ RADIATION

A. R. Jones Mar. 1968 11 p refs
(AECL-3023) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

The survey meter can be used for estimating gamma ray dose rates with two linear scales (0–3,000 and 0–10,000 rads/hour). It is intended for monitoring very high gamma fields in emergencies or, more routinely, intense fields which are quite localized. To provide some protection to the user the detector is at the end of a long extendible probe. The survey meter comprises a silicon junction gamma detector, dc amplifier and battery monitor circuit. The energy response of the detector permits an estimation of dose to the critical organ for high level exposure. The performance under varying conditions of gamma ray energy and direction as well as temperature is described. Author

N68-22745# Elliott Flight Automation Ltd., Rochester (England).

DEVELOPMENTS IN RATE GYROSCOPES

R. P. G. Collinson and A. R. Essex [1967] 26 p
(Publ.-281/58/1/67)

Gyroscopes are widely used in flight test instrumentation for measurement of angular rate of rotation. Object of the paper is to show the developments that have been made with these instruments, particularly in the cases of the spring restrained and the electrical force-balance rate gyroscopes. Self test features are discussed, together with methods of testing. Typical performance data are given. Author

N68-22756# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.

THERMISTOR TEMPERATURE CONTROL CIRCUIT

J. J. Henry 5 Feb. 1968 13 p ref
(Contract W-7405-ENG-26)
(Y-1602) CFSTI: HC$3.00/MF$0.65

An improved temperature-control circuit has been designed that employs a thermistor bridge with a nonlinear reference leg and a single-ended transistor amplifier. This circuit provides regulation to within ±0.3°C for control at any selected temperature between −40° and +70°C. The nonlinear reference leg allows reduction in the number of components, thus improving the reliability without sacrificing accuracy. Author (NSA)

N68-22780*# Spacelabs, Inc., Van Nuys, Calif.

PROPELLANT LEAKAGE DETECTION SYSTEM Final Report

8 Apr. 1968 191 p
(Contract NAS9-6649)
(NASA-CR-92086; SR-68-1050) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A prototype Propellant Leakage Detection System (PLDS) developed for space flight propulsion systems is capable of measuring extremely small leaks, monitoring propellant flow rates during reaction control system operation, or determining a catastrophic failure such as a line rupture or valve malfunction. A single meter houses both low flow and high flow sensors, which cover 30 cc/hr to 0.88 lb/sec of N_2O_4 and 40 cc/hr to 0.44 lb/sec of UDMH. The low flow sensor provides leakage detection and alarm signal output, and the high flow sensor a mixture ratio limit indicator; although both sensors can be used for continuous flow rate determination. A variable power with constant temperature difference technique and a variable sensor housing geometry were developed. The 1-g gravitational field effects were virtually eliminated from the prototype hardware, although a temperature compensation problem was not solved. M.W.R.

N68-22804# Los Alamos Scientific Lab., N. Mex.

MULTIPLE-IMAGE OBJECTIVE SYSTEM FOR A ROTATING-MIRROR CAMERA

S. D. Gardner 10 Aug. 1967 8 p refs
(Contract W-7405-ENG-36)
(LA-3797) CFSTI: HC$3.00/MF$0.65

An optical system is described which produces multiple images of an object on a rotating-mirror camera focal plane. The apparatus is made up of multiple optical trains, each train consisting of a pair of Dove prisms and collimating lenses which serve to form an image with arbitrary position and orientation at the camera focal plane. The instrument was designed to record the progress of a nonplanar shock wave or detonation wave along several nonparallel paths. When used with suitable object illumination it also permits framing pictures to be made of a dynamic event. Author (NSA)

N68-22814* Scripta Technica, Inc., Washington, D. C.

LOW DENSITY VISUALIZATION [VISUALISATION A FAIBLE MASSE VOLUMIQUE]

C. Veret NASA May 1968 12 p refs Transl. into ENGLISH from French Report Paper Presented at the 30th Reunion of AGARD on the New Exptl. Tech., Munich, 11–15 Sep. 1967
(Contract NASw-1694)
(NASA-TT-F-11509) CFSTI: $3.00 CSCL 14E

Comparison of the Schlieren and phase-contrast methods for visualization of aerodynamic flow at hypersonic velocities when the flow densities are low. Examples of wind-tunnel hypersonic flow visualizations are examined. It is shown that for very low densities (below 10^{-6} g/cm^3 the phase-contrast method exhibits significant sensitivity, and its sensitivity limit is approximately 100 times smaller than that of the Schlieren method. The high sensitivity imposes certain requirements involving the elimination of parasitic effects. Conditions are indicated for applying both methods to flows which are themselves luminous, such as plasmas and flames.
Author

N68-22834# Gulf General Atomic, San Diego, Calif.
DESCRIPTION AND OPERATION OF INTERMEDIATE ENERGY NEUTRON DETECTOR
J. C. Young 16 Aug. 1967 25 p
(Contract AT(04-3)-167)
(GA-8184) CFSTI: HC$3.00/MF$0.65

The design and operation of a plastic scintillation detector system for measuring neutron flux with high efficiency and low back-ground at 100 eV to 10 MeV are described. The collimated neutron beam is intercepted by an absorber which emits fission gamma rays which are detected by the system.
NSA

N68-22846# Mound Lab., Miamisburg, Ohio.
A DEVICE FOR DETERMINATION OF PRESSURE IN SEALED CONTAINERS
T. A. Furtsch and C. J. Kershner 12 Jan. 1968 10 p
(Contract AT(33-1)-GEN-53)
(MLM-1446) CFSTI: HC$3.00/MF$0.65

A device was developed which permits determination of the effective gas pressure inside a closed container such as a sealed capsule. In this device, the container is punctured and the gas is allowed to flow into a closed system containing calibrated volumes and pressure gages. The original pressure in the container being evaluated is determined by means of calculations based on the pressure-volume data obtained from the measuring device.
Author (NSA)

N68-22852# Weapons Research Establishment, Salisbury (Australia).
A LIGHT-WEIGHT OPTICAL REFRACTOMETER FOR FIELD USE
M. S. Brown Nov. 1967 23 p refs
(WRE-TN-ISD-89) CFSTI: HC$3.00/MF$0.65

A portable optical refractometer was developed which is capable of detecting variations in the atmospheric refractive index, of the order of 5×10^{-8} The instrument is described and some typical results are given.
Author

N68-22853# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
AIR MONITOR FOR PLUTONIUM 239 UTILIZING SEMICONDUCTOR DETECTOR
Victor R. Griep 24 Jan. 1968 14 p refs
(Contract AT(29-1)-1106)
(RFP-1046) CFSTI: HC$3.00/MF$0.65

A small compact air monitor was developed which permits continuous sampling procedures for plutonium. To monitor air samples at the many separate locations of a plutonium fabrication facility, a small inexpensive instrument has many advantages. Most commercial air monitors are not only expensive, but constructed in sizes too large for handling alongside other plant equipment. The new monitor is about one-fifth the size and one-fifth the cost of commercial units. The air monitor utilizes a semiconductor detector for sensing alpha-emitting contamination. The air-sampling arrangement consists of a flow meter and assembly to permit quick filter changes; a line-powered, transistorized amplifier and count-rate circuit; a count-rate meter; a warbling alarm; and recorder connections if needed. Included are photographs of the air monitor and schematic diagrams of the circuit and ratemeter boards.
Author (NSA)

N68-22877# Commissariat a l'Energie Atomique, Saclay (France).
ELECTRONIC DEVICE FOR MEASURING THE POLARIZATION PARAMETER IN THE $\pi^-p\to\pi^0n$ CHARGE EXCHANGE REACTION ON A POLARIZED PROTON TARGET [UN APPAREILLAGE ELECTRONIQUE DESTINE A LA MESURE DU PARAMETRE DE POLARISATION DANS LA REACTION D'ECHANGE DE CHARGE $\pi^-p\to\pi^0n$ SUR CIBLE DE PROTONS POLARISES]
Serge Brehin (Ph.D. Thesis—Grenoble Univ.) Dec. 1967 75 p refs In FRENCH; ENGLISH summary
(CEA-R-3357) CFSTI: HC$3.00/MF$0.65

An electronic apparatus has been constructed to measure the polarization parameter $P_0(t)$ in $\pi^-p\to\pi^0n$ charge exchange scattering at 5.9 GeV/c and 11.2 GeV/c on polarized proton target. This device insures triggering of a heavy plate spark chamber, allowing visualisation of γ rays from the π^0 decays when the associated neutron offers suitable characteristics in direction and energy. The neutron is detected by an array of 32 counters; energy is measured by a time of flight method. Electronic circuitry as well as test and calibration methods are described.
Author

N68-22883*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CAPACITOR-TYPE METEOROID-PENETRATION SENSORS: DESCRIPTION AND TEST RESULTS
John J. Broderick Washington May 1968 109 p refs
(NASA-TN-D-4529) CFSTI: HC$3.00/MF$0.65 CSCL 14B

Capacitor sensors were tested and evaluated, in various configurations, under hypervelocity-impact conditions which simulate, as nearly as possible with present laboratory facilities, the impacts of meteoroids in space. Light-gas guns, explosive devices, electrostatic accelerators, and exploding-wire guns were used. Three types of signals were observed during hypervelocity perforations. The first is characterized by a complete discharge of the sensor within a few microseconds. The second is characterized by the rapid discharge of a substantial portion of the applied voltage. The third is characterized by the loss of less than about 10 percent of the applied voltage with the discharge time in excess of 10 μsec. During the test program most of the perforations resulted in small signals or no signals. The applied voltage was the only parameter observed which had a pronounced effect on the sensor operation. Completely charged capacitor sensors were not permanently shorted when perforated by small single hypervelocity projectiles; however, some uncharged and partially charged sensors were permanently shorted when perforated.
Author

N68-22893# California Univ., Livermore. Lawrence Radiation Lab.
DESIGN AND TESTING OF A 100,000-PSI EDDY-CURRENT PRESSURE TRANSDUCER FOR HOSTILE ENVIRONMENTS
John E. Field 10 Oct. 1967 11 p refs
(Contract W-7405-ENG-48)
(UCRL-50341) CFSTI: HC$3.00/MF$0.65

This report describes the design and testing of an eddy current pressure transducer capable of transmitting accurate signals over long cables when subjected to a maximum pressure of 200,000 psi, high level gamma and neutron radiation, and accelerations several thousand times that of gravity. The minimum breakdown voltage of the system is 3000 volts. It was tested to 165,000 psi by means of an air gun operating through an amplifier using indium as the pressure transmitting medium.
Author (NSA)

N68-22923*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

PHOTOHELIOGRAPH STUDY FOR THE APOLLO TELESCOPE MOUNT

J. D. Allen, R. A. Happe, L. M. Michal, E. H. Rehnborg, and L. M. Snyder 1 Nov. 1967 110 p refs
(Contract NAS7-100)
(NASA-CR-94389; JPL-TM-33-369) CFSTI: HC $3.00/MF $0.65
CSCL 14E

An optimized flight-telescope system is analyzed to determine the feasibility of conducting a flight program with a moderate size solar telescope on the Apollo telescope mount. Information is summarized to obtain high-resolution photography in the near UV, white light, and near infrared. Problem areas are delineated for future study. Appendices review the geometry of the optics and a general plan to conduct the flight program. Author

N68-22929# Commissariat a l'Energie Atomique, Grenoble (France).

STUDY OF THE TEXTURE OF POROUS SOLIDS USING A TECHNIQUE OF γ RAY ABSORPTION [APPLICATION DE L'ABSORPTION DU RAYONNEMENT γ A L'ETUDE DE LA TEXTURE DES SOLIDES POREUX]

Miguel Ortega (Ph.D. Thesis—Grenoble Univ.) Jan. 1967 76 p refs In FRENCH
(CEA-R-3204) CFSTI: HC$3.00/MF$0.65

A technique, which enables the localized measurement of total porosity, open porosity and pore size distribution is developed. The total porosity is calculated from the bulk density. A gamma absorption gauge is set up provided with a Cs^{137} source. This enables the determination of the density by layers of carbonaceous samples in a practically automatic way. By taking adequate precautions it is possible to obtain the density with a maximum error $\Delta\rho \leq 0.005$ g/cm^3. The open porosity is evaluated by the absorption method after impregnation with bromoform. A mercury porosimeter is developed using the absorption probe for the measurement of mercury infiltrated into the porous sample. Due to the localized character of exploration by this technique, the variations of porous texture in a heterogeneous sample can be studied. Used as a classical porosimeter, in the case of homogeneous samples, this apparatus is capable of exploring the equivalent diameters of pores between 500 μ and 0.14 μ with a maximum error $\Delta\rho \leq 0.002$. The possibility of exploration of heterogeneous samples, with the facility of determination of porosities due to macropores combined with the nonlimiting character of the method in the field of high pressures differentiates this apparatus from all the porosimeters of former conception. Examples of utilization of this technique in the case of graphite-gas reactions are presented. Author

N68-22937# Bonn Univ. (West Germany).

MEASUREMENTS OF NUCLEAR MOMENTS OF STABLE NUCLEI WITH THE ATOMIC BEAM MAGNETIC RESONANCE METHOD [UNTERSUCHUNGEN ZUR BESTIMMUNG VON KERNMOMENTEN STABILER ATOMKERNE MIT HILFE DER ATOMSTRAHLRESONANZMETHODE]

S. Penselin Sep. 1967 21 p refs In GERMAN
(BMwF-FBK-67-80)

Improvements on two atomic-beam magnetic-resonance devices are outlined, and the results of measurements of the magnetic dipole moments of ^{63}Cu, ^{65}Cu, ^{165}Ho, and ^{87}Rb are presented. A measurement of the hyperfine structure in ^{175}Lu is also summarized. NSA

N68-22938# Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).

GRAVITY METER CALIBRATION RANGES IN AUSTRALIA

B. C. Barlow 1967 49 p refs
(Rept.-122) CFSTI: HC$3.00/MF$0.65

During 1960 and 1961, eight gravity meter calibration ranges were established throughout Australia. The gravity intervals of these calibration ranges were determined using groups of gravity meters calibrated between Ferntree Gully and Kallista in Victoria against a gravity interval determined from several pendulum stations. The results of individual determinations have been assessed in terms of the known variation in the calibration factors of the gravity meters and the estimated accuracy of the measurement of the interval. Many inconsistencies are present, but the weighted means of groups of determinations are believed to provide reasonably accurate estimates of the gravity intervals across the ranges. The Australian calibration system is compared with other calibration standards. The establishment of gravity meter calibration ranges in all States of Australia permits all users of gravity meters to adopt a common calibration for their meters, and assists in the integration of independent surveys. Author

N68-22970# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

DEVELOPMENT OF A SEMICONDUCTOR COUNTER TELESCOPE WITH LOW BACKGROUND FOR THE INVESTIGATIONS OF CHARGED PARTICLES PRODUCED IN REACTIONS INDUCED BY NEUTRONS [REALISATION ET MISE AU POINT D'UN TELESCOPE A SEMI-CONDUCTEURS ET A FAIBLE BRUIT-DE-FOND POUR L'ETUDE DES REACTIONS NEUTRONS-PARTICULES CHARGEES]

Jean-Marie Helleboid (Ph.D. Thesis—Grenoble Univ.) 1967 148 p refs In FRENCH; ENGLISH summary
(CEA-R-3378) CFSTI: HC$3.00/MF$0.65

A counter telescope for charged particles produced in reactions with neutrons was constructed. The semiconductor counter telescope method allows the investigations of two and three-body reactions induced by 14 MeV neutrons. By using a coincidence of associated alpha particle pulses with those in the telescope, the background is considerably reduced for all angles outside the coincidence cone, i.e. larger than 15°(L). For forward angles, the same telescope plus a thin semiconductor allows keeping a low background. The multiparameter analysing method from the experimental range-energy data gives a linearity, an efficiency and an identifying power which are satisfactory. The identification is performed by differed time on an IBM 7044 computer. Author

N68-22973# Commissariat a l'Energie Atomique, Saclay (France).

STUDY OF CARTRIDGE RUPTURE DETECTION INSTALLATIONS [CONTRIBUTION A L'ETUDE DES INSTALLATIONS DE DETECTION DE RUPTURES DE GAINE]

Paul Douet, Jean Graftieaux, and Andre Roguin Dec. 1967 91 p refs In FRENCH
(CEA-R-3342) CFSTI: HC$3.00/MF$0.65

The physical and technological parameters involved in the installation of instruments for detecting fuel jacket ruptures are discussed. Considered are reactor design, type of detector used, arrangement of pneumatic circuits, type of fuel used, and safety requirements. Problems are analyzed regarding compatibility of installation, probability of simultaneous multiple ruptures, and accidental contamination of the equipment. K.W.

N68-22986# Commissariat a l'Energie Atomique, Saclay (France).

GERMANIUM JUNCTION DETECTORS. THEORETICAL AND PRACTICAL FACTORS GOVERNING THEIR USE IN RADIATION SPECTROMETRY [DETECTEURS A JONCTION AU GERMANIUM. ELEMENTS THEORIQUES ET PRATIQUES POUR L'UTILISATION EN SPECTROMETRIE DE RAYONNEMENTS]

Michel Hors and Claude Philis Nov. 1967 89 p refs In FRENCH; ENGLISH summary
(CEA-R-3251) CFSTI: HC$3.00/MF$0.65

Semiconductor detectors have greatly increased the possibilities available to nuclear spectroscopists for the study of α, β and γ radiations. Their use in radiochemistry has encouraged the study of their principle, their mechanism and also the conditions under which they can be used. Theoretical data are summarized on the best use of junction detectors, in particular Ge (Li) detectors. The laboratory work carried out over a period of one year on Ge (Li) detectors is discussed. Stress is laid on the possibilities presented by the use of these detectors as photoelectric spectrometers, and also on the precautions required. Among the numerous results presented, the resolution of 2.52 keV obtained for the γ radiation of 145.5 keV for ^{141}Ce may be particularly noted. Author

N68-22990# Commissariat a l'Energie Atomique, Saclay (France).
IMPROVEMENTS OF THE SENSITIVITY OF BURST CARTRIDGE DETECTION [AMELIORATION DU SEUIL DE DETECTION DES RUPTURES DE GAINE]
Fernand Vasnier Dec. 1967 28 p refs In FRENCH
(CEA-R-3330) CFSTI: HC$3.00/MF$0.65

Details are given on the tests carried out on fission product detectors by a process in which gas is continuously injected in front of the scintillator. Using this system, the background is reduced and perturbations caused by pneumatic switches on the prospection circuits are eliminated. The quality of the signals thus obtained permits better processing of the data and thus leads to possible improvement in the sensitivity of burst cartridge detection. Also given are the results of tests carried out with both fresh and aged gases, the economic advantage of the latter being that it permits recycling through the reactor. Reduction of the background is less pronounced but the advantage of the stable signals is conserved. Author

N68-23012# Sandia Corp., Albuquerque, N. Mex.
EVALUATION OF THICK QUARTZ DISK (TQD) TRANSDUCERS Activity Report, 5 Jul.–31 Aug. 1967
B. W. Duggin 31 Aug. 1967 45 p refs
(Contract AT(29-1)-789)
(SC-DC-67-3204) CFSTI: HC$3.00/MF$0.65

The evaluation of thick quartz disk (TQD) transducers was made to determine the feasibility of using TQD's to measure short rise time, high intensity shock pulses encountered in shock tube tests. NSA

N68-23014# California Univ., Livermore. Lawrence Radiation Lab.
A SEMI-AUTOMATED THERMOLUMINESCENT DOSIMETER READER
K. F. Petrock and D. E. Jones 8 Jan. 1968 18 p refs Presented at the Intern. Symp. on Nucl. Electron. and Radioprotection, Toulouse, 4–8 Mar. 1968
(Contract W-7405-ENG-48)
(UCRL-70860; CONF-680302-2) CFSTI: HC$3.00/MF$0.65

An improved thermoluminescent dosimeter (TLD) reader is described with principle features of unattended readout of 80 TLD's after manual loading, heating of the TLD's with hot nitrogen gas, and versatile electronics that allow simultaneous readout of the glow curve and integrated light output. A prototype unit reads 80 extruded LiF rods over a dynamic range of 3 mR to 300 R in 40 minutes. Digital light output and glow curves suitable for computer analysis were produced with the reader. Current improvements should increase the dynamic range at least an order of magnitude and higher doses can be read by filtering the light output or lowering the photomultiplier tube voltage. Planned modifications will be discussed. Author (NSA)

N68-23020# Commissariat a l'Energie Atomique, Cadarache (France).
MEASUREMENT EQUIPMENT FITTED IN LIGHT VEHICLES USED FOR SUPERVISION AND RECONNAISSANCE BY THE RADIOPROTECTION SERVICE AT CADARACHE [EQUIPEMENT DE MESURES DES VEHICULES LEGERS DE SURVEILLANCE ET DE RECONNAISSANCE DE LA S. P. R. CADARACHE]
Antoine Galanti, Claude Thirion, and Marc Grandin Dec. 1967 36 p refs In FRENCH
(CEA-R-3324) CFSTI: $3.00

These vehicles are used to reinforce the atmospheric supervision network based on four fixed stations. In case of a planned atmospheric discharge they control contamination levels and check that these conform to the scattering forecasts. In case of accidental atmospheric pollution, their role is to rapidly demarcate the pollution zones and to follow the evolution of this pollution. The main measurements carried out are: (1) detection of ambient gamma radiation from 10 µrad/hr to 1000 rad/hr; (2) detection of the alpha and gamma contamination; and (3) detection of the beta and gamma contamination of the ground. Author

N68-23021# Commissariat a l'Energie Atomique, Saclay (France).
ELECTRODE-LESS CONDUCTIVITY METER [CONDUCTIMETRE SANS ELECTRODE]
Michel Degryse and Francois Bourg Dec. 1967 17 p refs In FRENCH
(CEA-R-3344) CFSTI: HC$3.00/MF$0.65

The apparatus described in this report measures continuously, with an accuracy of better than 1% the conductivity of solutions containing large amounts of inorganic products. The design of this industrial apparatus results in the elimination not only of the drift which can affect the measurements, but also of difficulties normally found in conventional electrode conductivity meters. The characteristics are as follows: (1) range 500 and 1000 mhos; (2) sensitivity threshold 0.5% of the maximum signal; and (3) output range 0–50 mV, 0–10 volts. Author

N68-23023# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
DEVELOPMENT OF A FREE-FIELD SOIL STRESS GAGE FOR STATIC AND DYNAMIC MEASUREMENTS Final Report
James K. Ingram Feb. 1968 108 p refs Sponsored by DASA
(TR-1-814; AD-666769)

The report describes the development of three free-field stress gage types. One gage design, the sand dollar gage, was abandoned early in the investigation, while the other two, the W and SE gages, were subjected to various evaluation tests. Static and dynamic tests in sand and clay were conducted in the Small Blast Load Generator (SBLG). The gages have been used in the laboratory evaluation of a cold gas loader and in two field tests. Evaluation of the performance of the gages in these tests is presented in Appendix A. The gage placement techniques used in the SBLG tests are described in Appendix B. The gages are rugged and relatively easy to place in the laboratory. They may be used for both static and dynamic measurements and have a linear pressure range from 1 to above 1,800 psi. The gages have very low acceleration sensitivity and hysteresis, and have excellent dynamic response capability. Their temperature sensitivity is such that it will be of little consequence in dynamic tests and can be corrected for in long-term static tests. Electrical sensitivity remains essentially constant from -30 to 150F. Of the two gage types discussed, the SE gage is recommended for use. It is much easier to place, is more rugged, and produces a cleaner dynamic signal than the W gage. The gages can be calibrated to compensate for registration errors due to differences in soil and gage modulus; however, gage registration was found to be a function of placement method, depth of burial, input pressure, and conditions of the medium, not simply of modulus ratio. Author (TAB)

N68-23029*# General Dynamics/Convair, San Diego, Calif.
DESIGN, FABRICATION AND PERFORMANCE OF AN ELLIPSOIDAL SPECTROREFLECTOMETER
J. T. Neu Mar. 1968 108 p ref
(Contract NAS2-3769)
(NASA-CR-73193) CFSTI: HC$3.00/MF$0.65 CSCL 20F

A far infrared ellipsoidal spectrophotometer provides wavelength coverage from 2.5 to 90 μ, and has potential from 0.2 to 360 μ. Its angular coverage is from 6 to 76 deg, with potential to as high as 80 deg. Components of the spectrophotometer are described, including the ellipsoid, transfer optics, chopper, detectors, amplifiers, filters, and windows. Alignment procedures are detailed for the measuring instrument, operation and maintenance are discussed, and determination of sample reflectance near normal and angular measurements are included. A design was evolved in which the sample investigated is 1 inch in dia and in which tap water thermostating at the sample back surface is provided; and four sample holders are provided. M.W.R.

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N68-21898*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF TANTALUM-TO-STAINLESS-STEEL TRANSITION JOINTS
Adolph C. Spagnuolo Washington Apr. 1968 29 p refs
(NASA-TM-X-1540) CFSTI: HC$3.00/MF$0.65 CSCL 13E

Tantalum-to-stainless-steel bimetallic transition joints were tested to determine the overall strength of the brazed joint. Tensile tests were conducted on flat sheet and tubular specimens at elevated temperatures 1350°F and vacuum levels of 10^{-7} to 10^{-8} torr. Studies were also conducted to determine if any unfavorable interdiffusion embrittlement was taking place between the braze material and the parent metals. A 2.5-inch diameter by 0.125-inch wall bimetallic joint was subjected to the temperature 1350°F and pressure 350 psia levels expected in a liquid metal loop including 20 temperature cycles between 600°F and 1350°F. The tests indicated: (1) The parent material in all tensile specimens ruptured first, leaving the brazed area intact. (2) No significant interdiffusion occurred between the braze and the parent metals. (3) The 2.5-inch diameter tube remained leak tight after 150 hours of testing at 1350°F and 350 psia. Ultimate and yield strength data are also included for unalloyed tantalum rods, plate and sheet test specimens at 1350°F at vacuum levels of 10^{-8} to 10^{-7} torr. Author

N68-21916*# Beech Aircraft Corp., Boulder, Colo.
DEVELOPMENT OF CRYOGENIC POSITIVE EXPULSION BLADDERS Final Report, Jun. 18, 1965–Dec. 31, 1967
D. H. Pope and J. E. Penner 20 Jan. 1968 398 p refs
(Contract NAS3-6288)
(NASA-CR-72115; ER-15091) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Polymeric materials, composites, and various fabrication techniques were qualification tested for evaluation of flexibility and permeability characteristics in cryogenic liquids. Ten 11.5 inch spherical bladders fabricated of the five best qualified material composites were comprehensively tested and eight bladders attained the test goal of 25 complete liquid hydrogen expulsion cycles, although there was failure of material in some bladder plies. Several material composites utilizing Mylar and Kapton demonstrated excellent expulsion and permeability performance. Extensive data on liquid hydrogen expulsion was obtained and a much greater knowledge was acquired of the characteristics and behavior of bladders composed of 10 or more individual plies. Author

N68-21965*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTS ON STABILITY OF HERRINGBONE GROOVED GAS-LUBRICATED JOURNAL BEARINGS TO HIGH COMPRESSIBILITY NUMBERS
Robert E. Cunningham, David P. Fleming, and William J. Anderson Washington Apr. 1968 21 p refs
(NASA-TN-D-4440) CFSTI: HC$3.00/MF$0.65 CSCL 13K

Experiments were conducted with six rotors, 1-1/2 inches (3.8 cm) in diameter by 12-1/4 inches (31.1 cm) long and equipped with two herringbone-grooved journals. These rotors were operated in plain cylindrical sleeves to high compressibility numbers with ambient air as a lubricant. Vertical orientation of the rotors without any applied radial load presented a test condition most conducive to existing half-frequency whirl (HFW). These experiments showed that HFW threshold speeds are very much dependent on radial clearance. Five rotors running at clearances from 370 to 500 microinches (9.4 to 12.7 μm) did not whirl up to the limiting speed of the air turbine drive. When the same rotors were operated at clearances ranging from 550 to 710 microinches (14 to 18 μm), HFW was experienced at fairly low speed ranges of from 14,750 to 27,900 rpm. Limited test results comparing a fully grooved with a partially grooved rotor showed the fully grooved rotor to be stable up to 60,830 rpm. The partially grooved rotor having the same operating parameters except for groove length exhibited HFW at 27,900 rpm. Agreement between experimental and theoretical results is generally quite good. Based on these results the theory tends to be somewhat conservative in defining zones of unstable operation. Author

N68-21979*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A REVIEW OF LUBRICATION OF SLIDING AND ROLLING-ELEMENT ELECTRICAL CONTACTS IN VACUUM
John S. Przybyszewski Washington Apr. 1968 33 p refs
(NASA-TN-D-4476) CFSTI: HC$3.00/MF$0.65 CSCL 11H

The operation of sliding- or rolling-element electrical contacts in vacuum presents a problem because of the occurrence of high noise levels, high coefficients of friction and excessive wear rates due to the absence of beneficial surface films. Thin metallic films are seen as a promising method of lubrication. Three methods of thin film deposition and the endurance lives of these films (obtained from friction experiments) are discussed. On the basis of the reviewed experimental data, some conclusions are made regarding the performance of the various electric contact materials and lubricants in vacuum. Author

N68-22094*# Rocketdyne, Canoga Park, Calif.
INDUCER DYNAMICS, PARTIAL FLOW HYDRAULIC TURBINE DRIVE Interim Report, Jul. 1967–Jan. 1968
J. A. King Feb. 1968 184p
(Contract NAS3-10280)
(NASA-CR-72379; R-7427) CFSTI: $3.00 CSCL 13K

Two computer programs, an analog and a digital, have been developed that will predict the transient performance of a low speed inducer driven by a hydraulic turbine. An inducer–turbine unit has been designed and fabrication is in progress. Steady state maps of the pertinent components of this unit have been constructed from existing test data and by synthetic mapping procedures. These maps have been used in the computer programs to predict the performance of this unit in the system in which it will eventually be tested. Parametric studies have been made to determine the effect of selected changes in this system. The computer program has also been used to investigate several inducer–turbine combinations in simulated rocket engine installations. Author

N68-22114*# Goodyear Aerospace Corp., Akron, Ohio.

FLEXIBLE VACUUM JACKET DEVELOPMENT Final Report

22 Jun. 1967 167 p
(Contract NAS8-11376)
(NASA-CR-94236; GER-13342) CFSTI: HC $3.00/MF $0.65
CSCL 13D

Details are given on a program encompassing materials and process development of flexible envelopes for insulated vessels containing cryogenic liquids. The various tests conducted to obtain a flexible vacuum jacket material include spring back, permeability, and vacuum seam testing; and vacuum jacket to tank penetration attachment testing. The results are assessed, and a 0.002-inch thick Mylar–aluminum–aluminum–Mylar laminate construction weighing 0.0187 lb/ft^2 was selected on the basis of light weight and low permeability. The design and fabrication of vacuum jacket to envelope a multilayer insulation as applied to the 105-inch diameter LH$_2$ test tank are discussed. Consideration is also given to the development and fabrication of a flexible purge jacket for a 70-inch diameter LH$_2$ test tank which would serve to contain helium purge gas in a multilayer insulation system during ground hold, and automatically open to vent the purge gas during the ascent phase. B.S.D.

N68-22336*# National Aeronautics and Space Administration, Washington, D. C.

SPACE RESOURCES FOR THE HIGH SCHOOL INDUSTRIAL ARTS RESOURCES UNITS

John L. Feirer (Western Mich. Univ.) Apr. 1967 178 p refs
Presented at the Space Technol. Conf. for Ind. Arts Educ.
(NASA-EP-44) CFSTI: HC $3.00/MF $0.65 CSCL 13H

This bulletin is a reference manual addressed to industrial arts teachers, supervisors, and teachers' educators; it provides specific suggestions for fusing space related teaching subjects into industrial arts courses. Each teaching topic has a bibliography composed of specific NASA Technical Briefs, NASA Special Publications, and commercially available texts representative of the latest developments in technology. K.W.

N68-22611*# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.

HAND-HELD ELECTRON BEAM GUN AND EXTERNAL POWER SUPPLY Final Report, Jun. 1965–Oct. 1966

Glen S. Lawrence and F. Richard Schollhammer Oct. 1966 61 p ref
(Contract NAS9-4501)
(NASA-CR-62059; EBR-199) CFSTI: HC $3.00/MF $0.65 CSCL 13H

The design, development, and evaluation of an operable, prototype hand-held electron gun capable of joining space-age materials in a high vacuum environment are described. The electron optics and power (Watts) required to weld typical aerospace materials of representative thickness are defined on the basis of a study which indicated that most in-space fabrication tasks would involve joining predominantly stainless steel, aluminum or titanium alloys of approximately 0.75 inch thickness. A detailed description is given of the systematic development tests and the results obtained for each major component prior to its integration into the complete gun assembly. Weld penetration capabilities of the prototype gun are given for various typical aerospace materials. For all materials investigated, the simulated in-space electron beam welds exhibit greater depth-to-width ratios and smaller grain sizes than those obtained in conventional fusion welding of similar specimens. The reliability and safety of the hand-held device are demonstrated in the results of man-rated space chamber tests which completed the evaluation. E.J.S.

N68-22618# Bettis Atomic Power Lab., Pittsburgh, Pa.

TESTING AND SELECTION OF MATERIALS FOR WEAR APPLICATIONS IN HIGH PURITY WATER

N. B. Dewees Apr. 1967 22 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-T-1977) CFSTI: HC $3.00/MF $0.65

The essential differences between testing in pure research and testing for specific applications are described. Problems encountered in testing for wear applications in high purity water are discussed. These problems relate primarily to variability of results, response to changes in test parameters, and degree of simulation. Corrosion influences are briefly mentioned. Interpretation of existing data in the light of these problems is also discussed. The significance of wear test results falling into different characteristic patterns is shown. Precautions which must be observed in planning and conducting a wear test program and in interpreting wear test data are presented. Author (NSA)

N68-22687# Sandia Corp., Albuquerque, N. Mex.

ROLAMITE: A NEW MECHANICAL CONCEPT

D. F. Wilkes Dec. 1967 215 p refs Supersedes SC-RR-67-656
(Contract AT(29-1)-789)
(SC-RR-67-656A; SC-RR-67-656) CFSTI: HC $3.00/MF $0.65

The rolamite geometry forms an extremely tolerant precision rolling suspension suitable for a wide range of applications and does not require precision tolerance machining to manufacture. Rolamite exhibits coefficients of friction 1 to 10 percent of the values obtained from conventional bearings; no lubrication is required. Rolamite geometry produces axial forces of any desired character. The simplicity of the rolamite geometry enables the design of innumerable complete electromechanical devices composed of only 4 to 10 piece-parts. Author (NSA)

N68-22766* Lockheed-Georgia Co., Marietta.

NONDESTRUCTIVE TESTING FOR EVALUATION OF STRENGTH OF BONDED MATERIALS (METALLIC)

Sherman E. Cohen 28 Feb. 1968 8 p refs
(Contract NAS8-20627)
(NASA-CR-61747) CFSTI: $3.00 CSCL 13H

Selected abstracts from a bibliographic list are presented on the nondestructive testing for evaluating strength of bonded metallic materials. B.S.D.

N68-22767* Lockheed-Georgia Co., Marietta.

NONDESTRUCTIVE TESTING FOR EVALUATION OF STRENGTH OF BONDED MATERIALS (METALLIC)

Sherman E. Cohen 1 Sep. 1966 11 p refs
(Contract NAS8-20627)
(NASA-CR-61748) CFSTI: $3.00 CSCL 13H

A bibliographic list on nondestructive testing for evaluating the strength of bonded metallic material is presented. B.S.D.

N68-22777*# Avco Corp., Lowell, Mass.

EXPERIMENTAL ASSEMBLY AND STERILIZATION LAB ROUTINE CLEANING AND DECONTAMINATION

E. J. Lunney 15 Apr. 1967 17 p Prepared for JPL
(Contract NAS7-100)
(NASA-CR-94390; AVSSD-0121-67-CR; EASL-202-01; L-202.00)
CFSTI: HC $3.00/MF $0.65 CSCL 13H

Procedures for routine cleaning and decontamination of the Experimental Assembly and Sterilization Laboratory (EASL) are outlined; and personnel, equipment and other requirements are listed. Special safety instructions are given; the preparation of cleaning and germicidal solutions as well as cleaning equipment is outlined; and quality assurance provisions are noted. The procedure outline includes cleaning schedule, equipment operation, details of the entire process, personnel procedures, semi-annual cleaning, and microbiological assay. M.W.R.

N68-22778*# National Aeronautics and Space Administration, Washington, D. C.

METHOD OF BRAZING ALUMINUM TO STAINLESS STEEL FOR HIGH-STRESS-FATIGUE APPLICATIONS

D. C. Martin 1968 16 p refs Prepared by Battelle Memorial Inst.

(NASA-SP-5040) CFSTI: HC $3.00/MF $0.65 CSCL 13H

A procedure for minimizing the formation of intermetallic compounds in aluminum-stainless steel joints is discussed that uses a titanium coating on the stainless steel to act as a diffusion barrier. This Ti alloy layer is coated with an aluminum-silicon alloy, and the joint is made by brazing the Al part to the coated stainless steel part. In the case of an age-hardenable Al part, aging takes place after brazing. Applications of the procedure are mentioned; problems of joining Al to iron-base alloys are noted; and diffusion barrier for Ti and Al coatings, brazing, and joint properties are discussed. M.W.R.

N68-22810*# Case Inst. of Tech., Cleveland, Ohio.

A CRITICAL EVALUATION OF THE STATUS AND TRENDS IN HIGH SPEED FLUID FILM LUBRICATION

E. S. Kulinski and S. Ostrach Washington NASA May 1968 25 p refs

(Grant NGR-36-003-004)

(NASA-CR-1058) CFSTI: HC $3.00/MF $0.65 CSCL 11H

High speed lubrication (also denoted as turbulent and superlaminar lubrication) and relevant parts of the fluid mechanics literature are reviewed. It is contended on the basis of this review that existing turbulent journal bearing calculations are predicted on an unrealistic characterization of the lubricant film. Furthermore, an order-of-magnitude argument is presented which indicates that the neglect of inertial terms in the governing equations of turbulent lubrication is incorrect. It is concluded that fundamental investigations on the structure of high speed lubricant films must precede the formulation of an adequate theory, and the nature of these investigations is discussed. Author

N68-22820* Hughes Tool Co., Houston, Tex. Research Dept.

DEVELOPMENT PROGRAM OF A LUNAR AND PLANETARY GEOSAMPLING DEVICE, PHASE 2 Final Report, Oct. 1967–Jan. 1968

Jan. 1968 83 p refs Prepared for JPL

(Contracts NAS7-100; JPL-951480)

(NASA-CR-94401) CRFSTI: $3.00 CSCL 13I

A breadboard model of a geological acquisition and transport device has been designed, manufactured, tested, redesigned, and retested. Drilling and transporting testing in several lunar soil sampling models was conducted on this B-1 sampler. Drilling, transporting, particle size distribution analyses, and density sorting data were gathered to evaluate the performance of the sampler. Author

N68-22981* Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.

C-1 ENGINE PROGRAM: PHASE 2 DEVELOPMENT, BIPROPELLANT VALVE IMPROVEMENT PROGRAM

31 Aug. 1967 102 p refs Add. No. 1 to RMD-6203-F1

(Contract NAS9-15486)

(NASA-CR-61731; RMD-6203-F1, Add. 1) CFSTI: $3.00 CSCL 13K

A program designed to improve the vibration characteristics of the bipropellant valve used on the C-1 engine is reported. Documented are test data obtained during vibration evaluations of the existing valve design, and of various design concepts developed to eliminate the vibration problem. The purpose of these tests was to obtain information on the resonance behavior of the valve body and the torque motor armature-flexure sleeve assembly and the effects of certain modifications on this behavior. Two bipropellant valve test specimens were modified by the addition of a flat spring motion restrictor to each flapper-button. The test specimen successfully completed all unpressurized vibration tests and performance tests without malfunction. On the basis of test results it is concluded that: (1) the revised design feature greatly improved the vibration characteristics of the bipropellant valve when exposed to the unpressurized vibration levels which is the most severe environment; and (2) the valve assembly can meet or exceed the specified unpressurized vibration requirements and can satisfactorily pass all functional tests following the vibration tests. S.C.W.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N68-21937# Harvard Univ., Cambridge, Mass. Lyman Lab.

REPORT ON DEVELOPMENT OF LARGE STORAGE BOX ATOMIC HYDROGEN MASER

E. Uzgiris 5 Mar. 1968 19 p refs

(Contract Nonr-1866(53))

(AD-666298)

The principal source of error in absolute time and frequency measurements with the atomic hydrogen maser arises from the effect of the wall surface of the storage container on the frequency of the maser. Although the effect is small and can be measured by experiments using storage bulbs of two different diameters, an error in the absolute frequency determination remains which is about a factor of ten larger than the characteristic frequency instability of the hydrogen maser. One method of improving this limitation is by finding more suitable wall materials. However, even without an improvement in the materials, the wall effect can be reduced by confining the atoms in a larger diameter storage box since the fraction of time an atom spends on the wall is inversely proportional to the storage box diameter. Improved wall materials developed in other studies could be applied as well to give an additional enhancement. TAB

N68-21969 Johns Hopkins Univ., Baltimore, Md.

ON THE PROPER USE OF LASER RADIATION IN THE CALIBRATION OF SPECTROMETER SCANNING FUNCTIONS

Louis Sica, Jr. (Ph.D. Thesis) 1966 115 p

Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-3004

The dependence of the spectrometer scanning function on the spatial coherence of the illumination at the entrance slit implies that the spatial coherence of laser radiation must be degraded before its narrow spectral bandwidth can be used to advantage in scanning function calibration. Partial coherence theory is used to obtain conditions on the correlation function which must be obtained in order to simulate an "incoherent source." It is shown that under some conditions this can be done with a source having a relatively large correlation interval provided that the correlation function has a favorable form. The experimental use of a method described by Beran and Parrent to determine the correlation function at the spectrometer entrance slit is reported. The results for an incoherent Hg source are in agreement with Hopkins' concept of an "effective source." Results using laser light reflected from an integrating sphere indicate that such a source may be used interchangeable with an ordinary incoherent source for scanning function calibration. Dissert. Abstr.

N68-22120 Stanford Univ., Calif.

COULOMB CORRECTIONS TO INELASTIC ELECTRON SCATTERING AND MASER OSCILLATOR THERMAL NOISE ANALYSIS

Leonard Samuel Cutler (Ph.D. Thesis) 1966 123 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-4339

The problem of making an improvement in the first Born approximation treatment of inelastic electron scattering involving Coulomb multipole transitions is approached by expressing the scattering cross section in terms of integrals over the nuclear transition charge density form factor with a kernel which contains all the electron physics. Distorted wave Born approximation is used and the interaction with the transverse electromagnetic field is neglected. Various approximations to the electron wave functions may be used to construct the kernel leading to varying degrees of accuracy in the results. Dissert. Abstr.

N68-22131 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SYSTEM OF SYNCHRONIZATION OF STARTING FOR LASER WITH PULSE QUALITY

V. A. Pilipovich and Yu. F. Morgun *In its* J. of Appl. Spectry. 11 Sep. 1967 p 16–18 (See N68-22129 12-23)

A laser synchronization system featuring an FD-1 photodiode is described and shown. The proposed system differs from existing systems, which use photocells or photomultipliers, in that it eliminates the need for complex power supplies, is very compact, and is convenient and reliable in operation. The system consists essentially of a receptacle with an aperture, which is mounted axially with respect to the total-internal-refraction prism. An SM-36 type bulb is placed in the receptacle. An FD-1 type photodiode is inserted into a cylinder at the same level as the aperture in the receptacle. Laser firing is achieved when the bulk is switched in, causing light to be incident through the aperture on the photodiode. When this happens, the photodiode resistance decreases, which triggers the thyratron and supplies the firing pulse to the flash lamp. The switching circuit is shown. The desired Q-switching delay time for any rotation rate of the prism can be regulated by appropriate rotation of the cylinder with respect to the rotation axis. The proposed system operated without failure for 18 months. Author

N68-22263 Lockheed Missiles and Space Co., Palo Alto, Calif.

ON THE USE OF LASERS FOR A SEPARATE DETERMINATION OF THE STRESSES IN POLARIZED OPTICAL INVESTIGATIONS

A. I. Aleksandrov and M. Kh. Akhmetzianov [1968] 6 p refs
Transl. into ENGLISH from Prikl. Mekh. i Tekhn. Fiz. (USSR), no. 5, 1967 p 120–122

An apparatus is described for using the coherent radiation from a helium–neon laser light source to obtain photographs of lines of equal sums of the principal stresses in plane elastic models and photoelastic coatings (isopaches). The deficiencies in existing interferometers are explained as being due to the use of existing light sources, and the use of lasers is recommended due to the extremely high degree of monochromaticity and coherence to be obtained. In the apparatus described, interference fringes are observed which are caused by the interaction of rays reflected from the surfaces of the model or photoelastic coating in the form of lines of equal thickness. These are photographed twice, before and after loading of the model, or at two stages of stress. The difference between the two photographs obtained then yields an isopach map for the investigation of the elastic plane model or photoelastic coatings. E.J.S.

N68-22313*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

A SURVEY OF LASER DISPLAY

D. W. Kennedy, C. R. Grauling, A. J. Devaney, and R. D. Wright *In its* Recent Advan. in Display Media 1968 p 93–109 refs (See N68-22302 12-09)

Present laser display systems may be classified into one of two distinct categories: those systems based on moving (scanned) laser beams, and those systems utilizing the concepts of holography. Of these two classes of laser display, those devices of the former category reflect the more advanced state of development. At this time, there are at least three complete display systems utilizing a scanned laser beam. This advanced state of development is due, in part, to the fact that flying spot display techniques are well known from industrial CRT experience. The field of holography, on the other hand, is relatively new and not as well developed. Holographic displays offer more potential for realistic three-dimensional imaging than any other display technique developed to date. In addition to display applications, holography is being found to have uses in many other fields including pattern recognition, data processing, and stress analysis. Author

N68-22817# Commissariat a l'Energie Atomique, Saclay (France).

MOLECULAR LASERS FOR THE FAR INFRA-RED [LES LASERS MOLECULAIRES EN INFRA-ROUGE LOINTAIN]

Denis A. Degras Dec. 1967 2m p refs In FRENCH; ENGLISH summary
(CEA-BIB-108) CFSTI: HC $3.00/MF $0.65

The laser theory is briefly recalled for atomic and molecular systems. In the far infrared spectrum the most important wave lengths are close either to 10 microns or to 100 microns. Gas lasers are used. The first range is obtained with CO_2, N_2O, CS_2, and OCS into which are added N_2 or N_2 and He. The continuous power (cW) is roughly 50 W/m. Q-switch techniques yield 50 kW for 10^{-3} joule. The laser power depends upon the chemical dissociation which occurs as a result of the discharge. The second range is observed with H_2O, D_2O, H_2S (80 to 220 microns) and with HCN, CH_3CN, and C_2H_5CN (337 microns). Some infrared detectors and numerous molecular laser applications are reviewed. Author

N68-22913*# Case Inst. of Tech., Cleveland, Ohio.

THE HOLLOW CATHODE DISCHARGE APPLIED TO LASER DESIGN

Thomas F. Trost and W. B. Johnson [1968] 63 p refs
(Grants NsG-198; NsG(T)-42)
(NASA-CR-94391; A-46) CFSTI: HC $3.00/MF $0.65 CSCL 20E

The possibility of achieving laser action in the sputtered metallic vapor of a hollow cathode glow discharge is investigated. Intensity measurements are carried out on the spectral lines emitted by the vapor in the cathode region of copper and iron hollow cathode tubes. The measurements are analyzed using a graphical technique designed for identifying inverted excited state populations. The method is limited by a lack of known gf-values for ionic states. In the literature, various possibilities for resonance collisions between sputtered metal ions and carrier gas atoms are discovered. A suitable copper-helium collision is found for achieving a population inversion among the excited states of copper ions. A copper cathode laser is constructed, but laser action is thus far not observed. Author

N68-22935*# Case Western Reserve Univ., Cleveland, Ohio.

FREQUENCY SHIFTS INHERENT IN THE 6328 Å HELIUM-NEON LASER

T. P. Sosnowski and W. B. Johnson Nov. 1967 79 p refs
Sponsored in part by ARPA and Goodyear Aerospace Corp.
(Grant NsG-198)
(NASA-CR-94394; A-57) CFSTI: HC $3.00/MF $0.65 CSCL 20E

The effects of various discharge tube parameters on the center frequency of the Doppler-broadened ($3s_2$–$2p_4$) 6328 Ang. lasing transition in Ne^{20} and Ne^{22} have been measured. Frequency shifts from 17-1/2 to 23 MHz/torr were measured in the discharges depending on the combination of helium and neon isotopes used. The shift of the peak frequency with discharge tube current was immeasurable (<1 MHz/10 ma.). In addition, it has been found that the peak frequency is dependent on the relative position of the tube axis with respect to the cavity axis, the variation for small bore tubes being of the order of 20 MHz/0.1 mm. Finally, an analysis is made of the possible causes for the pressure frequency shifts, the result being that they may be attributed to collisions between the excited neon atoms ($3s_2$ level) and ground state helium atoms. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N68-21851 Illinois Univ., Urbana.
MECHANISMS OF ENVIRONMENT INDUCED SUBCRITICAL FLAW GROWTH IN AISI 4340 STEEL
William Alan van der Sluys (Ph.D. Thesis) 1966 45 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-6761

The results of an experiment designed to study the effect of several variables on the subcritical crack growth rate of a high-strength steel in a water environment are presented in this paper. Double cantilever beam specimens of an AISI 4340 steel, heat treated to a yield strength level of 217,000 psi. with a fracture toughness of $K_{Ic} = 51.5$ ksi. $\sqrt{\text{in.}}$, were employed to study crack extension rates. The environmental variables included temperature, pH of the liquid environment, electric charging, and the combined effect of pH and electric charging. It was concluded from these results that both hydrogen enbrittlement and chemical corrosion assisted crack growth. The relative contributions of the two mechanisms were dependent on the pH and the applied potential. Dissert. Abstr.

N68-21852 Pennsylvania State Univ., University Park.
INVESTIGATION OF DISPERSION HARDENING MECHANISMS BY ELECTRON TRANSMISSION MICROSCOPY
Patrick John Smith (Ph.D. Thesis) 1966 107 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-5971

The purpose of the thesis was to investigate the stability of thorium dioxide particles in TD-Nickel. The composite material, consisting of 2 percent thoria dispersed in a nickel matrix, was annealed at various temperatures and the single particle size distribution and percentage of particles in clusters were studied as a function of temperature using electron transmission microscopy. The structure of thoria particles was investigated by carbon extraction replica technique. Finally, hardness tests were used to determine the effect of annealing treatments on mechanical properties. It was found that the thoria particle size distribution in TD-Nickel is unaffected by annealing treatments to 1200°C for 200 hours. The hardness of cold worked TD-Nickel decreases with increasing temperature for 200 hour anneals to approximately 700°C, after which the hardness has a constant value. The average diameter of the thoria particles was found to be 325 Å. Using the value of average particle diameter, the Orowan prediction of the yield stress of TD-Nickel was calculated to be in the range 15–30 kg/mm^2, depending on the assumed type of particle distribution. This compares well with a measured tensile stress of 30 kg/mm^2 reported in the literature. Dissert. Abstr.

N68-21855 Pennsylvania State Univ., University Park.
STUDIES IN MULTIAXIAL LOW CYCLE FATIGUE AND DYNAMIC CREEP
John Shewchuk (Ph.D. Thesis) 1966 236 p
Available from Univ. Microfilms: HC $10.80/MF $3.05 Order No. 67-5965

A theoretical and experimental study on the prediction of biaxial low cycle fatigue failure from uniaxial data. The proposed basis of correlation is the total octahedral shearing strain range, and the strain range is calculated using the effective value of Poisson's ratio which is derived for elastic-plastic loading. A general theory for taking into account mean strain in low cycle fatigue by modifying completely reversed data is presented. Also, a theory is presented for determining the effective octahedral shearing strain for anisotropic materials under conditions of uniaxial and biaxial stress by relating directional fatigue strength and fracture ductility. In part two, failure from stresses of magnitudes and frequencies encountered in high cycle fatigue and in the creep temperature range is considered. A failure theory, based on independent consideration of creep and fatigue mechanisms, is proposed. Good agreement is obtained between experimental data for commercially pure aluminum under varying ratio of alternating to mean stress and the proposed theory. Dissert. Abstr.

N68-21875*# Benson (Robert W.) and Associates, Inc., Nashville, Tenn.
DEVELOPMENT OF NON-DESTRUCTIVE METHODS FOR DETERMINING RESIDUAL STRESS AND FATIGUE DAMAGE IN METALS Final Report
8 Mar. 1968 157 p refs
(Contract NAS8-20208)
(NASA-CR-61584) CFSTI: HC$3.00/MF$0.65 CSCL 11F

Methods of measuring stress within various alloys of aluminum using both shear and surface waves were developed. Transducers were designed for determining the relative ultrasonic velocities along the principal axes of stress. Relationships were established for a number of aluminum alloys between the ultrasonic velocity and stress. From the relationships, it is possible to determine the magnitude of stress that exists within a particular portion of a metallic structure. A special instrument has been designed and constructed which allows for the measurement of ultrasonic frequency differences which are also related to stress. Microwave frequencies and techniques were used to take advantage of small, high "Q" resonators, and to confine the resistance measurements to a few millionths of an inch of the surface. An increase in surface resistance was found to precede any visual evidence of fatigue damage and impending fatigue. Author

N68-21917*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DEFORMATION PROCESSING OF PRECIPITATION-HARDENING STAINLESS STEELS
D. E. Strohecker, A. F. Gerds, and F. W. Boulger Redstone Arsenal, Ala. Redstone Sci. Inform. Center [1968] 278 p refs
Prepared by Battelle Mem. Inst. for Army Missile Command
(NASA Order H-76715; Contract DA-01-021-AMC-11651(Z))
(NASA-SP-5088; RSIC-495) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Both primary and secondary fabrication methods for the precipitation-hardenable stainless steels are covered. Methods currently employed for primary fabrication of these alloys include rolling, extrusion, forging, and drawing of tube, rod, and wire. Secondary metalforming operations are those processes that produce finished or semifinished parts from sheet, bar, or tubing using additional metalforming operations. The following secondary forming processes are discussed: brake bending, deep drawing, spinning and shear forming, drop hammer, trapped rubber, stretch, roll forming, dimpling, joggling, and sizing. Equipment and tooling used for the various operations are discussed and illustrated wherever possible. Author

N68-21960 California Univ., Los Angeles.
THE DIFFUSION OF URANIUM IN TANTALUM AT TEMPERATURES EXCEEDING 2600°C
George Bruce Taylor (Ph.D. Thesis) 1966 67 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-6514

The diffusion couple of uranium metal in tantalum was determinated at 4280, 4490 and 4563°F. The diffusion coefficients were measured by fitting the cylindrical diffusion equations for cylindrical diffusion with the experimental results. Since the diffusion depth was small compared to the radius of the cylinder, the linear approximation to the diffusion equation was also fit for comparison. Diffusion of uranium in tantalum was observed at three temperatures above the melting point of uranium dioxide. Below the melting point of uranium dioxide, no diffusion was observed with resolution of approximately 1.5 microns. The diffusion coefficients which were calculated with both the linear and cylindrical diffusion equation were nearly equal. The activation energy for the diffusion of uranium in tantalum was calculated from the diffusion coefficients at three temperatures and equals 100.5 Kcal/mole. Dissert. Abstr.

N68-21963# Stanford Univ., Calif.
THE INFLUENCE OF SUBSTITUTIONAL SOLUTES ON THE CARBON ACTIVITY IN AUSTENITIC, TERNARY, IRON-BASE ALLOYS
Richard Robert Zupp (Ph.D. Thesis) 1966 180 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-4457

The influence of substitutional solutes on the activity of interstitial C in ternary austenitic Fe-base alloys was investigated. The primary objectives of the study were (1) to experimentally measure the influence of V and Ti on the C activity in austenitic Fe-C-V and Fe-C-Ti alloys; (2) to develop analytical expressions to describe the results of such measurements for austenitic Fe-C-Z alloys, where Z represents any substitutional solute; and (3) to develop a theoretical treatment of an appropriate solution model for such alloys to explain the experimentally-observed behavior. A method was developed to utilize previously available data for the dependence of the C activity on the C content of Fe-C alloys to determine the C activity in other materials. Samples of the Fe-C alloy and the materials under investigation were equilibrated with respect to C content in a closed quartz cell containing a carrier gas to selectively transfer C. Dissert. Abstr.

N68-21977 Ohio State Univ., Columbus.
AN INVESTIGATION OF THE BASIC MECHANISMS OF MECHANICAL FRETTING AND FRETTING-FATIGUE AT METAL-TO-METAL JOINTS, WITH EMPHASIS ON THE EFFECTS OF FRICTION AND FRICTION-INDUCED STRESSES
Wayne Donald Milestone (Ph.D. Thesis) 1966 294 p
Available from Univ. Microfilms: HC $13.30/MF $3.80 Order No. 67-6346

The objective of the research described was to investigate the fundamental mechanisms of fretting and fretting-fatigue at metal-to-metal contacts. Included are: (1) A theoretical determination of the stresses induced into fretting surfaces and an analysis to determine the significance of these stresses. (2) A description of a specially designed test facility, with a special force-transducer and associated instrumentation for obtaining data about the interface frictional forces and metallic contacts, for inducing fretting under controlled conditions. (3) The results obtained from an experimental program, including data on coefficient-of-friction, metal-to-metal contact, and fatigue strength for different combinations of normal load, material, and surface conditions used for fretting. Dissert. Abstr.

N68-22080 Illinois Univ., Urbana.
LOW CYCLE FATIGUE STRENGTH INVESTIGATION OF A HIGH STRENGTH STEEL
William Olga Hartsaw (Ph.D. Thesis) 1966 54 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-6624

Nonreversed cyclic loading was imposed upon engineering sized specimens made of T-1 steel. The cyclic loading was controlled by maximum strain and maximum constant load in order to obtain a complete strain history of the specimens subjected to loads approaching the ultimate limit for each type of specimen and to determine the effect of a notch upon load-cycle life. The cycles controlled by the maximum strains gave evidence of cyclic softening of the material. However, when the load was removed for a period of time, or the strain limit was increased the load required for the following cycle was increased. Using cyclic constant maximum loading, strain history was obtained by successively mounted strain gages. The load-cycle to fracture life for the notched and unnotched specimens under constant maximum load cycling gave evidence of a definite transition point. Dissert. Abstr.

N68-22090 Illinois Univ., Urbana.
THE INFLUENCE OF THE IMPURITY IRON ON THE ANNEALING TEXTURE OF ALUMINUM
William Theodore Becker (Ph.D. Thesis) 1966 150 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-6553

This investigation was initiated in an attempt to show that iron is at least one element which controls the selection of the softening mechanism which may be recovery rather than recrystallization. Using high purity aluminum and iron, dilute alloys containing up to 0.06 weight per cent iron were prepared. Each alloy was then given two rolling and annealing treatments, one treatment designed to put all iron into solid solution and the other to precipitate as much iron as possible. After the rolling and annealing treatments, material was cold rolled 98 per cent and given a final anneal at 300°C. The deformation texture prior to final annealing, as well as textures at several annealing times, were then determined. Results show that if a small amount of iron is in solid solution, soft annealing results in no change in texture from that of the as-rolled material, implying that only recovery occurred during softening. However, if material is given a precipitation anneal, the material does recrystallize and forms nearly complete cube texture. Dissert. Abstr.

N68-22099 Illinois Univ., Urbana.
TRANSITIONAL IMPURITIES IN LIQUID COPPER
John Arvy Gardner, Jr. (Ph.D. Thesis) 1966 154 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-6616

High temperature susceptibility in both liquid and solid copper was measured for dilute solutions of elements belonging to the first transitional series. The solutes Co, Cr, Fe, and Mn possessed localized magnetic moments, and impurity moments calculated from susceptibility changed little on melting. The Cu^{63} Knight shift in liquid copper decreased by dissolved transition impurities with the maximum decrease of about 20% for each atomic percent of impurity occurring in the Cu-Mn solutions. The change caused by magnetic impurities in the Knight shift depended inversely on temperature. Knight shift results were analyzed using a single OPW approximation for the conduction electrons and the Friedel virtual bound state picture for the transition impurities. The resonance shifts predicted by this model are smaller than those found experimentally for magnetic solutes. Dissert. Abstr.

N68-22113# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
ELECTRONIC STRUCTURE OF CARBIDES AND NITRIDES OF FACE-CENTERED CUBIC TRANSITION METALS OF THE NaCl TYPE [STRUCTURE ELECTRONIQUE DES CARBURES ET DES NITRURES DE METAUX DE TRANSITION CUBIQUES FACES CENTREES DE TYPE NaCl]

Paul Costa 1967 100 p refs In FRENCH Submitted for publication
(ONERA-TP-540) CFSTI: HC$3.00/MF$0.65

The characteristic physical properties of transition metallic carbides and nitrides are reviewed to confirm existing physical data. A band model including electronic specific heat, magnetic susceptibility, and thermoelectric power is presented; as are calculations of strong liaisons of the band structure of these transition metal compounds. ESRO

N68-22122 Rensselaer Polytechnic Inst., Troy, N. Y.

CONTROLLED POTENTIAL INVESTIGATIONS OF LOCALIZED CORROSION PHENOMENA

Walter de Wayne France, Jr. (Ph.D. Thesis) 1966 79 p
Available from Univ. Microfilms: HC $4.20/MF $3.00 Order No. 67-4167

Localized corrosion phenomena, including intergranular attack, crevice corrosion, and pitting, have been investigated utilizing controlled potential corrosion tests. The precise environmental conditions necessary for the intergranular corrosion of austenitic stainless steels have been determined. Selective grain boundary attack of sensitized 18Cr-8Ni type stainless steel occurs only in limited potential regions. The complete correlation of electrochemical data with conventional chemical tests has been used to develop a new method for rapidly predicting the intergranular corrosion tendencies of various sulfuric acid environments. It is also shown that sensitized stainless steels may be used in many media without the occurrence of intergranular attack. Dissert. Abstr.

N68-22170 Lehigh Univ., Bethlehem, Pa.

THE CRYSTALLOGRAPHY OF THE REVERSE MARTENSITIC TRANSFORMATION IN AN IRON-NICKEL ALLOY

Stanley Shapiro (Ph.D. Thesis) 1966 72 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-4877

The crystallographic features of the martensite to austenite, or reverse martensitic transformation, in an Fe-33 wt. pct. Ni alloy have been determined by X-ray, light and electron microscopic techniques. Two distinct habit planes result from the transformation. The predominant habit plane is $\{0.1736, 0.3090, 0.9336\}_M$, the secondary habit plane is $\{0.3746, 0.5446, 0.7490\}_M$. Application of the phenomenological theory to a variant of the primary habit plane defines the plane and direction of the second shear as $\{0.7716, \overline{0.2284}, \overline{0.5948}\}_M$ and $[0.6361, 02284, 0.7373]_M$ respectively. Both replica and thin foil observations of high densities of tangled dislocations and possible twinning which constitute the fine structure of the reversed austenite plates support the irrational nature of the second shear. It is concluded that the irrational plane and direction of the fine structure actually represent the vector sum of the displacements on intersecting slip or twinning planes. The second habit plane could result from the variable nature of the inhomogeneous deformation as well. Dissert. Abstr.

N68-22201*# Cornell Univ., Ithaca, N. Y. Applied Physics Dept.

CHEMICAL REACTIONS AT METAL SURFACES Annual Progress Report, May 1, 1967–Apr. 30, 1968

Lester H. Germer 30 Apr. 1968 7 p refs
(Grant NGR-33-010-029)
(NASA-CR-94332) CFSTI: HC$3.00/MF$0.65 CSCL 11F

The effects of hydrogen and oxygen on a (110) nickel surface were studied experimentally. It was found that nickel atoms on the crystal surface rearranged at room temperature under hydrogen exposure; at intermediate temperatures and in an oxygen atmosphere, the growth of islands of clean metal modified the course of the reaction and thus increased oxygen reduction rate with time. Analysis of ammonia catalysis on single crystal tungsten surfaces showed that ammonia adsorbed without decomposition. When a surface covered by ammonia was heated, hydrogen evolved at 500°K leaving NH_2 radicals on the surface; further heating continuously stretched the hydrogen bonds and expanded the structure in the [110] surface direction until the bonds broke and the NH_2 radicals held independently to the surface until they vaporized in the form of N_2 and atomic hydrogen. Work function measurements during absorption of oxygen on tungsten crystal planes increased with oxygen coverage. The tungsten crystal planes (112) and (100) exhibited the same work functions after oxygen and heat treatment. G.G.

N68-22209 Northwestern Univ., Evanston, Ill.

INVESTIGATION OF THE PREPRECIPITATION PROCESS IN THE Au–Ni SYSTEM

Orville Fred Kimball 1966 348 p
Available from Univ. Microfilms: HC $15.75/MF $4.45 Order No. 67-4239

The low temperature preprecipitation process in gold-rich alloys of the Au–Ni system was studied by electrical resistance, x-ray diffraction, transmission electron microscopy and magnetic techniques. The preprecipitation process was shown to be the homogeneous formation of coherent Ni-rich platelets (G.P. zones) with {100} habit planes. The maximum thickness of the zones was about 4Å for Au-20 at. pct. Ni, 6Å for Au-40 at. pct. Ni. The zone thickness did not change with aging times longer than necessary to produce the maximum in the change of electrical resistance versus aging time. The zone diameters increased slowly with aging time but the maximum dimensions obtained were about 100Å diameter for the 20 at. pct. Ni alloy and 60Å diameter for Au-40 at. pct. Ni. About 10 pct. strain is associated with the zones; this indicates that the zones are nearly pure Ni. The zones in Au-40 at. pct. Ni are aligned in <100> directions. In Au-20 at. pct. Ni, however, the directions on densest packing are <110>. Dissert. Abstr.

N68-22227*# Techtran Corp., Glen Burnie, Md.

THE CORROSION RESISTANCE OF CERTAIN METALLIC MATERIALS FOR ASTRONOMICAL MIRRORS [O KORROZIYNOY USTOYCHIVOSTI HEKOTORYKH METALLICHESKIKH MATERIALOV DLYA ASTRONOMICHESKIKH ZERKAL]

Zh. M. Loretsyan Apr. 1968 5 p Washington NASA Apr. 1968 5 p Transl. into ENGLISH from the Soobshch. Biurakanskoy Observ. (Yerevan), v. 38, 1967 p 58–65
(Contract NASw-1695)
(NASA-TT-F-11658) CFSTI: HC$3.00/MF$0.65 CSCL 11F

An experimental study was conducted on the corrosion resistance of the aluminum–magnesium alloy AMg6L with chromium or nickel coatings, as well as bronze and 3 Khl3 steel used in fabricating astronomical mirrors. The metals were tested under special laboratory conditions simulating the corrosive effects of the ambient atmosphere and certain chemical solutions on astronomical mirrors. A chromium-film surface is shown to be most suitable as the protective coating. The bronze and AMg6L alloy mirrors are shown to have poor corrosion resistance. Author

N68-22295 Rensselaer Polytechnic Inst., Troy, N. Y.

RECRYSTALLIZATION AND OXIDATION BEHAVIOR OF AN AL–AL_2O_3 SAP-TYPE ALLOY BY HOT STAGE TRANSMISSION ELECTRON MICROSCOPY

Natesh Ramchandran (Ph.D. Thesis) 1966 120 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-4191

The oxidation of an Al-2% Al_2O_3 SAP-type alloy was observed by hot stage transmission electron microscopy, electron diffraction and motion picture micrography. Cold rolled and thinned polycrystalline foils were heated in situ and direct observation of oxide formation, types of oxides formed, mode of growth at different temperatures, growth rates and dynamic interaction with second phase particles were made. The recrystallization behavior of an Al-2% Al_2O_3 SAP-type alloy was observed by hot stage transmission electron microscopy and electron diffraction. Cold rolled and thinned polycrystalline foils were heated in situ and the recrystallization process was studied as it occurred. Sequential and selected area diffraction micrographs were taken as the foil was being heated. In order to correlate these observations with the recrystallization process occurring in bulk materials, foils from the same alloy were also cold rolled and then recrystallized to various degrees. Dissert. Abstr.

N68-22322# Polish Academy of Sciences, Warsaw.
DILATOMETRIC INVESTIGATIONS OF THE TRANSFORMATION $\beta \rightarrow \alpha$ IN U–0.4 % WT. Cr ALLOY [BADANIA DILATOMETRYCZNE KINETYKI PRZEMIANY $\beta \rightarrow \alpha$ W STOPIE U–0,4 % CIEZ. Cr]
A. Hofman 1967 23 p refs In POLISH; ENGLISH summary
(Rept.-874/14/PS) CFSTI: $3.00

Isothermal transformation $\beta \rightarrow \alpha$ of U–0.4 wt % Cr alloy in the temperature range 640°–400°C was investigated by the dilatometric method. The known kinetic equations were used for quantitative determination. The C-curve for the transformation was obtained. Activation energy for the process was calculated. The possibility of two C-curves on the temperature range 640°–400°C was discussed. Author

N68-22324 Lehigh Univ., Bethelem, Pa.
A STUDY OF THE INFLUENCE OF MICROSTRUCTURE ON THE MECHANICAL BEHAVIOR OF A MOLYBDENUM–TITANIUM–CARBON ALLOY
John Russell Thompson, Jr. (Ph.D. Thesis) 1966 73 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-4880

The mechanical properties of the alloy were determined via tensile tests at room temperature and at temperatures in the range of 0.44–0.51 T_m. The results of the room temperature tests suggest that the relationship between the yield strength of the alloy and the microstructure can be described by the Petch relationship: $\sigma_{y.s.} = \sigma_o + k_y L^{-1/2}$, where L is the fiber width. With the aid of the power law, it was found possible to predict the theoretical stress–strain behavior of the alloy. It was also found that the rate of strain-hardening and the strain-hardening exponent approach limiting values as the fiber width becomes smaller. No benefit appeared to be derived by including a 1700°C in-process heat-treatment in the fabrication schedule. The stress-relieved materials were stronger than the as-rolled 40-mil sheet. Metallographic examination of the materials after tensile testing at 1000° to 1200°C revealed that recrystallization had apparently begun on a large scale in the as-rolled materials while only slightly in the stress-relieved materials. Dissert. Abstr.

N68-22338*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE EFFECT OF INTERFIBER DISTANCE AND TEMPERATURE ON THE CRITICAL ASPECT RATIO IN COMPOSITES
Robert W. Jech and Robert A. Signorelli Washington May 1968 26 p refs
(NASA-TN-D-4548) CFSTI: HC$3.00/MF$0.65 CSCL 11F

The effect of distance and temperature on the minimum fiber length to diameter ratio in a fiber composite was examined using a modified pullout test. Tungsten-wire–copper, iron-wire–lead, and iron-wire–cadmium specimens were used. Variation of the critical aspect ratio as a function of interfiber distance was determined for the iron–lead and iron–cadmium systems. Critical aspect ratio as a function of temperature was determined for the tungsten–copper system. Reduction of the interfiber distance increased the apparent shear strength of the matrix as indicated by a reduction of the critical aspect ratio. A rapid increase in the critical aspect ratio was noted at test temperatures in excess of 1000°F (540°C). Author

N68-22341*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF COVER GAS PRESSURES UP TO 4 ATMOSPHERES ON ACCELERATED CAVITATION DAMAGE IN SODIUM
S. G. Young and J. R. Johnston [1967] 39 p refs Presented at ASME 1967 Winter Ann. Meeting, Pittsburgh, 12–16 Nov. 1967
(NASA-TM-X-61065) CFSTI: $3.00 CSCL 11F

Increasing cover gas pressures up to 4 atmospheres significantly increased cavitation damage to three materials: AISI type 316 stainless steel, L-605, and Stellite 6B in a vibratory test apparatus. Specimens were tested in sodium at 800°F. When volume loss was normalized to include only heavily damaged portions of specimens, damage increased exponentially with pressure for all materials. Materials were ranked with respect to cavitation damage resistance in the same order at high pressures as at low pressures. Metallographic studies were conducted to determine the nature of damage to the materials. Author

N68-22347 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
METALLOGRAPHIC AND X-RAY INVESTIGATIONS OF THE ISOTHERMAL TRANSFORMATION $\beta \rightarrow \alpha$ IN UCr, WITH 0.4 % WT. Cr ALLOY [BADANIA METALOGRAFICZNE I RENTGENOGRAFICZNE STRUKTUR PRZEMIANY IZOTERMICHZNEJ $\beta \rightarrow \alpha$ W STOPIE U-Cr 0,4 % CIEZ.Cr.]
Andrzej Hofman 1967 22 p refs In POLISH; ENGLISH summary
(IBJ-873/14/PS) CFSTI: HC $3.00

The isothermal phase transformation $\beta \rightarrow \alpha$ of U–0.4 wt% Cr alloy in the temperature range 630°–400°C was investigated by means of metallography and X-ray analysis. The results are in agreement with previous suggestion, based on the dilatometric mensurations, that there are two C-curves (in the given temperature range). An explanation of the existence of two transformation mechanisms $\beta \rightarrow \alpha$ for upper and lower C-curves is suggested. Author

N68-22357 Temple Univ., Philadelphia, Pa.
REFLECTOMETRIC MEASUREMENT OF THE OPTICAL CONSTANTS OF BETA-BRASS ALLOYS
Harold J. Goldman (Ph.D. Thesis) 1966 213 p
Available from Univ. Microfilms: HC $9.70/MF $3.00 Order No. 67-3214

The optical properties of beta-brass alloys have been analyzed in terms of: (1) free electron effects, (2) interband transition effects, and (3) collective electron effects. Dispersion theory was used to obtain an estimate of the average optical effective mass, m*, characterizing the free-electron behavior over the entire energy range below the onset of interband transitions. Utilizing the recent detailed band calculation results for beta brass, obtained by Johnson and Amar, the observed structure in the optical constant data was tentatively identified. This structure identification leads to a better theoretical understanding of the electronic behavior in beta brass. The variation of the collective resonance energies, the main interband transition energy, and the copper d-band interband transition energy with both temperature and composition has been interpreted in terms of m* Dissert. Abstr.

N68-22396 Lockheed Missiles and Space Co., Palo Alto, Calif.
ON METAL FATIGUE (T)
T. B. Larina [1968] 4 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 177, no. 1, Nov. 1967 p 59–60

The thermodynamic parameters affecting the fatigue characteristics of materials with complex properties are briefly examined. Equations are derived for the physical conditions of fatigue limit, plastic deformation, and the thermal slip velocity.
K.W.

N68-22401*# National Aeronautics and Space Administration, Washington, D. C.

INVESTIGATION OF THE THERMAL STABILITY OF THE MICROSURFACE OF ASTRONOMICAL MIRRORS FABRICATED FROM AMg6L ALLOY WITH CHROMIUM AND NICKEL COATINGS [ISSLEDOVANIYE NA TERMOSTOIKOST' MIKROPOVERKHNOSTI ASTRONOMICHESKIKH ZERKAL IZGOTOVLENNYKH IZ SPLAVA AMg6L S KHROMOVYN I NIKELEVYM POKRYTIYAMI]

Zh. M. Loresyan Apr. 1968 4 p Transl. into ENGLISH from Soobshch. Byurakansk. Observ., Akad. Nauk. ARM. SSR (Erevan), no. 38, 1967 p 66–71
(NASA-TT-F-11659) CFSTI: HC$3.00/MF$0.65 CSCL 11F

An experimental study was performed to determine the effects of low and high temperatures and differences in the linear expansion coefficient of the aluminum alloy AMg6L and electrolytic chromium or chemical nickel coatings on the microsurface quality of astronomical mirrors. Coatings of various thicknesses were tested at −95, +20, +60, and +100°C. Temperature variations had no effect on nickel films, but cracks appeared on the surface of chromium coatings thicker than 50 μ.
Author

N68-22451# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

AN IMPROVED METHOD FOR EXTRUDING AND SINTERING BERYLLIUM OXIDE

J. Bardsley and A. Ridal Aug. 1967 17 p refs
(AAEC/TM-401)

A technique for the extrusion and sintering of beryllium oxide to produce high density, fine-grained, high strength material was modified and improved. This resulted in beryllium oxide (250 ppM Fe) which, after extrusion and sintering for 5 hours at 1400°C in nitrogen, had an average grain size of 6 μm, a mean modulus of rupture equal to 34,840 psi when tested in 4-point bending, and a density range of 2.86 to 2.90 g/cm $^{-3}$. Further modifications reduced the variations in grain size and density of the sintered specimens and increased the mean modulus of rupture. For example, double extruded material, when sintered for 6 hours at 1400°C in nitrogen had an average grain size of 8 μm, a density of 2.92 g/cm $^{-3}$ and a mean modulus of rupture of 45,300 psi.
Author (NSA)

N68-22528# National Research Council of Canada, Ottawa (Ontario).

STUDIES ON ATMOSPHERIC CORROSION OF STEELS RELATED TO METEOROLOGICAL FACTORS IN JAPAN. 2. MULTIPLE CORRELATION OF METEOROLOGICAL FACTORS AND ATMOSPHERIC POLLUTION SUBSTANCES ON CORROSION OF STEEL

Kazuhiko Oma, Teruzo Sugano and Yoichi Hirai 1967 14 p refs Transl. into ENGLISH from Corrosion Eng. (Japan), no. 14(1), 1965 p 16–19
(NRC-TT-1281) CFSTI: HC$3.00/MF$0.65

The atmospheric corrosion rates of steel were measured in an industrial district of Tokyo, Japan. Analyzing correlations between the corrosion rates and meteorological factors and/or atmospheric pollution substance factors by means of statistical analysis method, a corrosion regression was obtained to describe the influence of these two mutual interacting factors on corrosion of steel.
Author

N68-22559# Argonne National Lab., Ill.

ELASTIC MODULI AND ULTRASOUND VELOCITIES OF TUNGSTEN AS A FUNCTION OF TEMPERATURE

Ronald G. Peterson Dec. 1967 10 p refs
(Contract W-31-109-ENG-38)
(ANL-7272) CFSTI: HC$3.00/MF$0.65

The results of a preliminary study of the elastic moduli and the ultrasound velocities of tungsten are given. The data were obtained by an ultrasonic pulse-echo method.
Author (NSA)

N68-22562# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

FLOATING-MANDREL EXTRUSION OF TUNGSTEN AND TUNGSTEN-ALLOY TUBING

R. E. McDonald and G. A. Reimann Feb. 1968 28 p refs
(Contract W-7405-ENG-26)
(ORNL-4210) CFSTI: HC$3.00/MF$0.65

Tungsten and tungsten-alloy tubing were extruded successfully from arc-cast and powder-metallurgy billets by use of the floating-mandrel technique with naturally forming tungsten oxide as a lubricant. Extrusion temperatures ranged from 1650 to 2250°C, and extrusion ratios were in the range of 4 to 9. Satisfactory service was obtained from zirconia-protected dies and mandrels, but surface melting of the container sleeve began when billet temperatures exceeded 1850°C. Rapid extrusion speeds were necessary to minimize heat loss and reduce contact time with the tooling. Thin-walled tungsten tubing was produced with the floating-mandrel technique by reextruding a section of tube shell in a duplex billet.
Author (NSA)

N68-22563# Oak Ridge National Lab., Tenn.

EFFECTS OF IRRADIATION ON DUCTILITY

J. O. Stiegler and J. R. Weir, Jr. Jan. 1968 55 p refs Presented at ASM Seminar on Ductility, Cleveland, 14–15 Oct. 1967 Submitted for publication
(Contract W-7405-ENG-26)
(ORNL-TM-2019; CONF-671051-1) CFSTI: HC$3.00/MF$0.65

Aspects of metal deformation and fracture at high and low temperatures are discussed. An introduction is given to the concepts involved in neutron irradiation and to changes in the lattice introduced by irradiation. These are illustrated by electron micrographs of irradiated materials. Changes in mechanical properties as a result of irradiation are described and explained in terms of the corresponding microstructural changes.
NSA

N68-22616# United Kingdom Atomic Energy Authority, Risley (England). Authority Health and Safety Branch.

NEUTRON INTERACTION DATA FOR TANTALUM IN THE ENERGY RANGE 1.0E−10 MEV TO 15.0 MEV

W. Hart Mar. 1968 43 p refs
(AHSB(S)-R-141) CFSTI: HC$3.00/MF$0.65

In the past few years, some high resolution measurements have been performed which, when combined with theoretical predictions, afford a detailed description of neutron interactions with the nuclide tantalum. From these and other sources of information, a set of neutron cross sections and other relevant parameters have been evaluated. They cover the energy range 1.0E−10 MeV to 15 MeV and are presented as a new data file for the Nuclear Data Library.
Author

N68-22636# Ludwig-Maximilians-Universitat, Munich (West Germany). Sektion Physik.

INVESTIGATIONS OF ALUMINUM FILMS WITH SYNCHROTRON RADIATION OF WAVELENGTHS 800 TO 1000 Å. A: POLARIZATION DEPENDENT TRANSMISSION AND REFLECTION. B: POLARIZATION DEPENDENT PHOTOEFFECT

M. Skibowski, B. Feuerbacher, W. Steinmann, and R. P. Godwin (Deut. Elektron.-Synchrotron) Oct. 1967 51 p refs
(DESy-67/33)

Measurements of the transmittance and reflectance of Al films as a function of wavelength, polarization, angle of incidence, and film thickness were carried out using synchrotron radiation together with a normal-incidence monochromator for the vacuum ultraviolet spectral region. Measurements were also made of the photocurrent from thin Al cathodes in a windowless electron multiplier as a function of wavelength, polarization, angle of incidence, and film thicknesses. NSA

N68-22643# Battelle Memorial Inst., Columbus, Ohio.

THE CHARGE ON INTERSTITIAL IONS IN GROUPS 4-A AND 5-A TRANSITION METALS Final Report

F. W. Collings 22 May 1967 99 p refs
(TID-24210) CFSTI: HC$3.00/MF$0.65

It was proposed to measure the charge on interstitial ions in Groups IV-A and V-A transition metals, by measuring the interstitial diffusion when a heavy current is passed through the specimen. The system of principal interest contains niobium–oxygen. Measurable migration was detected enabling the existence of interstitial oxygen as a positive ion to be determined, although quantitative results could not be obtained. A high-vacuum cell was used with a vac-ion pump to obtain much lower residual gas pressures. It is concluded that interstitial oxygen exists in niobium as a positive ion, and migration under the influence of an applied voltage is toward the cathode. Niobium has a positive Hall coefficient, so that evidence for migration of the interstitials under the influence of the hole flux (as distinct from the electrostatic field) was sought. No conclusive evidence for the operation of a hole flux was obtained. The Soret effect is of the same order of magnitude as the electromigration effect and the experiments show a negative heat of transport for oxygen in niobium resulting in an accumulation of interstitial atoms at the hot zone in the middle of the self-heated strip. NSA

N68-22649# North Carolina State Coll., Raleigh. Dept. of Engineering Research.

GRAIN BOUNDARY SLIDING IN ALUMINA BICRYSTALS Progress Report, 1 Apr.–30 Nov. 1967

Hayne Palmour, III, W. W. Kriegel, P. F. Becher, D. E. Witter, and M. L. Huckabee Dec. 1967 50 p refs
(Contract AT(40-1)-3328)
(ORO-3328-7) CFSTI: HC$3.00/MF$0.65

Dislocations, subgrain boundaries, and grain boundaries cause characteristic fine topographic features at their surface termini when alumina is thermally etched >1500°C in vacuo: flame grown crystals and pure and doped bicrystals synthesized from them were examined by optical and replication electron microscopy, and typical crystalline defects are illustrated. A new specimen configuration (designated as a double bicrystal) was successfully fabricated and tested; each specimen contains a central wedge-shaped crystal segment separated from the end segments by nonintersecting, orthogonal grain boundaries oriented ≈45° to the specimen axis. NSA

N68-22667# Oak Ridge National Lab., Tenn.

NIOBIUM CORROSION IN FLOWING LIQUID SODIUM AT 400 TO 600°C [CORROSION DU NIOBIUM PAR LE SODIUM LIQUIDE EN CIRCULATION ENTRE 400 ET 600°C]

Jacques Sannier, Louis Champeix, Raymond Darras, and Willy Graff Oct. 1966 22 p refs Transl. into ENGLISH from French
(ORNL-TR-1832; CEA-R-3028)

The corrosion of niobium and two of its alloys was studied under temperature, flow rate, and purity conditions of liquid sodium similar to those likely to occur in a fast neutron reactor. The results are discussed with reference to the following parameters: purification method used for the sodium, temperature, metallurgical condition of the structural metal. Generally speaking, an important role is played by the oxygen content of the liquid metal towards the corrosion of the niobium: although the metal behaves very satisfactorily when a hot trap purification is used, it undergoes corrosion in the presence of sodium which has been purified only by a cold trap. Author (NSA)

N68-22669# Los Alamos Scientific Lab., N. Mex.

STUDY OF THE DIFFUSION OF CARBON IN β ZIRCONIUM

R. A. Andrievskii, V. N. Zagryazkin, and G. Ya. Meshcheryakov 27 Jul. 1965 17 p refs Transl. into ENGLISH from Russian Presented at Symp. on Thermodyn. with Emphasis on Nucl. Mater. and Atomic Transfer in Solids, Vienna, 22–27 Jul. 1965 Submitted for publication
(LA-TR-67-32; STI/PUB/109, V. 2) CFSTI: HC$3.00/MF$0.65

An emulsion of radioactive C was deposited on specimens at β–Zr that were then annealed at 1100 to 1600°C for 0.5 to 5 hr in a vacuum (10^{-4} to 10^{-5} mm Hg), with measurements of temperature by means of Pt–PtRh and W–WRe thermocouples. After annealing the C films were stripped off the specimens and the activities of the specimens were measured by means of a scaling unit with an end-window counter. The activation entropy ΔS of the diffusion of C in β–Zr was calculated at 4.95 cal/mole-deg. The activation energy Q was found to be linearly dependent on the atomic radius of the element ($Q = 34.2$ kcal/mole for C), and the $\Delta S/Q$ ratio was found to be constant for the diffusion of various interstitial impurity elements (H, O, and N) into the same metal; other metals with bcc lattices, such as α–Fe or Ta are also governed by these laws. It is characteristic that the radius corresponding to "zero" activation energy is ≈0.25 Å, which satisfactorily tallies with the radius of octahedral pores in β–Zr ($r_{oct} = 0.243$ Å). NSA

N68-22674# California Univ., Berkeley. Lawrence Radiation Lab.

ACTIVATED HOT PRESSING OF MAGNESIUM OXIDE

Patrick Eugene Hart (Ph.D. Thesis) Dec. 1967 78 p refs
(Contract W-7405-ENG-48)
(UCRL-17978) CFSTI: HC$3.00/MF$0.65

The densification by pressure sintering of magnesium oxide compacts containing one-half to ten percent lithium fluoride was studied. This investigation gives insight into mechanisms involved in this fabrication process. Densification may be considered to be a three step process with the first two steps occurring in the fabrication die and the last step, annealing, being performed after pressing. The first stage in the die is a rapid process and is believed to be similar to the previously observed rearrangement stage. Depending on fabrication parameters, such as temperature, pressure, and initial lithium content, this initial stage may take place up to densities as high as 90% of theoretical, relative to pure magnesium oxide. Experimental evidence indicates that the final stage of densification in the die is controlled by flow of a lithium fluoride-rich phase along magnesia grain boundaries. Transport of magnesium oxide is by means of a solution-precipitation process. This analysis is valid for samples with densities between 91 and 99.5%. These two stages are separated by a transition or intermediate stage. The annealing stage is controlled by the evaporation of lithium fluoride from the sample surface. Samples having densities of 99.1% or more become transparent during annealing. Author (NSA)

N68-22781# National Lead Co. of Ohio, Cincinnati.

SUMMARY TECHNICAL REPORT, FOR THE PERIOD 1 OCTOBER–31 DECEMBER 1967

R. Burgett, ed. Feb. 1968 22 p refs
(Contract AT(30-1)-1156)
(NLCO-1010) CFSTI: HC$3.00/MF$0.65

Sixty-pound ingots were cast under controlled conditions to study the effect on uranium carbide segregation of carbon in the charge, temperature of the melt at the time of pouring, and mold temperature. The total carbon content of the ingot depended on the temperature of the melt at pouring and the carbides segregated more at higher pouring temperatures, at higher mold temperatures, and at higher ingot carbon levels. The resistance to deformation and hardness of cast uranium containing as much as 1000 ppM of each of two of the following elements: carbon, iron, silicon, and aluminum, was measured at temperatures ranging from 885 to 1200°F. Silicon and aluminum additions caused greater resistance to deformation and greater hardness than did carbon and iron. Cathodoluminescence may provide a useful analytical technique and extend the range of the electron microprobe. Quantitative analysis using cathodoluminescence is shown to be mathematically possible. Qualitative analysis is considered possible in special cases. A number of anticipated problems are discussed. Author (NSA)

N68-22782# Combustion Engineering, Inc., Windsor, Conn. Nuclear Power Dept.

VANADIUM PURIFICATION Quarterly Progress Report, 1 May–30 Sep. 1967

Y. S. Shen, S. Worcester, J. C. La Vake, and S. S. Christopher Nov. 1967 32 p
(Contract AT(30-1)-3742)
(CEND-3742-325; QPR-4) CFSTI: HC$3.00/MF$0.65

A 27.1-pound high-purity vanadium ingot was produced using commercial melting equipment and techniques. However, this ingot does not meet the target requirements of the program in that the interstitial content is high, and the ingot too small. As specified for this program, the target impurity levels are $O \leq 300$, $N \leq 100$ and $C \leq 100$ ppM with a final ingot weight of approximately 100 pounds. Chemical analysis on the 27-pound ingot showed generally a high nitrogen content (approximately 300 ppM) with the remaining impurity elements within the target values. Although this ingot did not meet the target requirements, much information was learned concerning control of chemistry as a result of processing this ingot. Fabrication of a third ingot has been started and information derived from processing the second ingot will be used to control the chemistry within the target requirements and produce a 100-pound ingot. Author

N68-22825# Lockheed Missiles and Space Co., Palo Alto, Calif.

ON METAL FATIGUE (T)

T. B. Larina 4 Jan. 1967 4 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 177, no. 1, 1967 p 59–60
(PB-177194T) CFSTI: HC$3.00/MF$0.65

Equations of state are derived which describe the thermodynamic parameters of one dimensional problems, and, by means of a holomomic model of a continuum, to describe materials with complex properties. It is shown that heating of the sample plays a decisive role in fatigue rupture of metals. E.J.S.

N68-22858# Iowa State Univ. of Science and Technology, Ames.

TECHNOLOGY AND USES OF BERYLLIUM, CESIUM, GERMANIUM, HAFNIUM, NIOBIUM (COLUMBIUM), RARE EARTHS (INCLUDING YTTRIUM AND SCANDIUM), TANTALUM, TITANIUM, AND ZIRCONIUM

Karl A. Gschneidner, Jr. Jan. 1968 158 p refs
(Contract W-7405-ENG-82)
(IS-1757) CFSTI: HC$3.00/MF$0.65

The chemical, metallurgical, and physical properties of beryllium, cesium, germanium, hafnium, niobium, rare earth, tantalum, titanium, and zirconium metals and their principal compounds are reviewed, especially in light of their importance in present day technology and applications. The use of these metals and their compounds in industry, and in basic and applied research, such as space, nuclear energy, and electronics, is discussed. Special problems associated with these materials are noted and commented upon. (253 references) Author (NSA)

N68-22884*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TEXTURE STRENGTHENING AND FRACTURE TOUGHNESS OF TITANIUM ALLOY SHEET AT ROOM AND CRYOGENIC TEMPERATURES

Timothy L. Sullivan Washington May 1968 32 p refs
(NASA-TN-D-4444) CFSTI: HC$3.00/MF$0.65 CSCL 11F

Preferred crystallographic orientation or texturing in metallic sheet can, under conditions of biaxial stress, result in strengthening considerably greater than that predicted for an isotropic material. Certain titanium alloys exhibit texturing. After it is rolled into sheet form, titanium alloyed with about 4 percent aluminum gives close to the ideal texture for maximum biaxial strengthening. The commercially available titanium alloy, Ti–5Al-2.5Sn, also exhibits texture strengthening. The effect of texturing on the yield, ultimate, notch, and weld strengths of both Ti-4Al-0.2O and Ti-5Al-2.5Sn extra-low-interstitial grade was determined by testing 0.020-inch-thick sheet in uniaxial and 1 to 2 biaxial stress fields at 20°, 77°, and 294°K. The biaxial test specimens were cylinders 6 inches in diameter and 18 inches long. In addition, plastic Poisson's ratios were determined at the three test temperatures. Author

N68-22895*# Volt Technical Corp., Washington, D. C.

CORROSION RESISTANCE OF SOME METALLIC MATERIALS FOR ASTRONOMICAL MIRRORS

G. M. Loretsyan Greenbelt, Md. NASA 8 May 1968 5 p Transl. into ENGLISH from Soobsch. Byurakansk. Observ. Akad. Nauk Arm. SSR (Armenian), v. 38, 1967 p 58–65
(Contract NAS5-12487)
(NASA-CR-94410; ST-MR-4A-10701) CSCL 11F

This is an experimental study of the corrosion resistance of the aluminum–magnesium alloy AMg6L with chromium or nickel coatings, as well as bronze and 3Kh13 steel used in fabricating astronomical mirrors. The metals were tested under special laboratory conditions simulating the corrosive effects of the ambient atmosphere and certain chemical solutions on astronomical mirrors. A chromium–film surface is shown to be most suitable as the protective coating. The bronze and AMg6L alloy mirrors are shown to have poor corrosion resistance. Author

N68-22915# Battelle Memorial Inst., Columbus, Ohio.

CORROSION RESISTANCE OF NICKEL AND TWO NICKEL ALLOYS TO GASEOUS BROMINE

Paul D. Miller, Elmer F. Stephan, Warren E. Berry, and Walter K. Boyd 4 Jan. 1968 12 p refs
(Contract W-7405-ENG-92)
(BMI-X-489) CFSTI: HC$3.00/MF$0.65

Bromine is formed when U_3O_8 is reacted with BrF_5 in the Fluidized-Bed Fluoride Volatility method of processing certain spent nuclear fuels. In support of development work on this process the corrosivity of gaseous bromine on plant construction materials was studied. Review of the literature showed that nickel and Monel are quite resistant to liquid bromine at ambient temperatures, provided the moisture content is low. Experimental work involving exposures in gaseous bromine at 300 and 500°C showed that coupon specimens of Nickel 201, Duranickel 301, and Huyck Felt-metal were much more resistant than Monel. The penetration rate on Monel was about 5 mils per month at 300°C, whereas the attack on the other nickel-base materials was negligible. At 500°C penetration rates of the order of 0.5 mil per month were measured for Nickel 201 and Duranickel 301. Some intergranular attack was also detected. Welded specimens behaved in the same manner. The presence of oxygen in the bromine at 300°C did not significantly affect corrosion behavior. Selective attack occurred on some areas of the Nickel 201 and Duranickel 301 specimens when Monel specimens were also in the system. It is believed that the attack was associated with the deposition of bromide salts formed when bromine reacted with the constituents in Monel, particularly copper. Copper specimens were rapidly attacked. Author (NSA)

N68-22930# Max-Planck-Institut fur Metallforschung, Stuttgart (West Germany). Institut fuer Sondemetalle.

STUDIES ON ALUMINUM-RICH URANIUM ALLOYS [UNTERSUCHUNGEN AN ALUMINIUMREICHEN URANLEGIERUNGEN]

G. Petzow and H. E. Exner Dec. 1967 64 p refs In GERMAN
(BMwF-FBK-67-88)

Investigations of Al–U alloys with ternary additions have shown that stabilization of the UAl_3-phase with respect to UAl_4 is not caused by retarded UAl_4 formation, but it can definitely be explained by the equilibrium structure of the corresponding ternary systems. The formation of a two phase relation between UAl_3 and Al is prerequisite for a stable UAl_3 phase in Al–U alloys with less than 10 at % U. The constitution of the systems $Al–UAl_2–ZrAl_2$, $UAl_2–NiAl$ and $Al–UAl_2–NiAl$ is presented. Furthermore, results of oxidation resistance studies of several intermetallic phases are reported. Author (NSA)

N68-22947# Iowa State Univ. of Science and Technology, Ames.

REFRACTORY METAL-CARBIDE SYSTEMS

Jack Paul Tosdale (M.S. Thesis) May 1967 100 p refs
(Contract W-7405-ENG-82)
(IS-T-219) CFSTI: HC $3.00/MF $0.65

Melting points and lattice parameters were measured for compositions in the following systems: TaC–ZrC, TaC–HfC and NbC–ZrC–UC. Preliminary phase studies were done on the Ta–C system near the monocarbide stoichiometry to determine the effect of carbon vaporization, at high temperatures, on the melting point. The oxidation resistance of ternary solutions of NbC–ZrC–UC were also measured. The experimental techniques for determining the melting points and lattice parameters are described along with some theory on the optical pyrometry used in the melting point determinations. All of the systems studied displayed complete solid solubility at room temperature. In the two binary systems, both the solidus curves and the lattice parameter-composition curves varied somewhat negatively from linearity. The solidus surface of the NbC–ZrC–UC ternary system tends to curve above a plane drawn through the melting points of the components represented in elevation at the three apexes of an equilateral triangle. The lattice parameter-molar composition surface contained a slight negative deviation from a plane passed through the lattice parameters of the individual carbides in a triangular space diagram. The oxidation resistances of binary mixtures of UC and NbC or ZrC were increased by the addition of the third component. Author (NSA)

N68-22955# Oak Ridge National Lab., Tenn.

THE PROGRAM OF THE RADIATION METALLURGY SECTION, SOLID STATE DIVISION, OAK RIDGE NATIONAL LABORATORY

M. S. Wechsler Feb. 1968 49 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2059) CFSTI: HC $3.00/MF $0.65

Radiation damage and radiation hardening and embrittlement in the body-centered cubic metals are discussed. The problem of the radiation embrittlement of pressure vessel steels and the applied aspects of the problem are under investigation. The research covers work on commercial steels, iron and iron alloys, and refractory metals. The significance of the research and its bearing on materials problems in nuclear technology are discussed. Author (NSA)

N68-22956# Oak Ridge National Lab., Tenn.

PRELIMINARY STUDY OF PYROLYTIC TUNGSTEN DEPOSITION

D. O. Hobson Jan. 1968 37 p
(Contract W-7405-ENG-26)
(ORNL-TM-2074) CFSTI: HC $3.00/MF $0.65

For a better understanding of the process of pyrolytic tungsten deposition pressures, flow rates, and H_2/WF_6 ratios for specific mandrel sizes and a specific mandrel temperature were optimized. Deposition efficiency varied with both pressure and gas ratio. Data on total flow rates, WF_6 flow rates, amount deposited, and efficiency are presented graphically. X-ray diffraction showed the deposits to be preferentially oriented in the growth direction. Analysis of the data indicated that the tendency for nodular growth was a direct function of gas composition. The experimental results were extrapolated to produce working hypotheses for predicting the behavior of tungsten deposition under a variety of conditions. Author (NSA)

N68-22963# Sandia Corp., Albuquerque, N. Mex. Metallurgy Div.

ROLE OF SUBGRAINS DURING THE CREEP OF PURE ALUMINUM

Charles Stein Dec. 1967 37 p refs
(Contract AT(29-1)-789)
(SC-RR-67-2975) CFSTI: HC $3.00/MF $0.65

An electron microscopy study was made of the behavior of the substructure developed in pure aluminum during creep at 260°C and a constant stress of 1000 psi. During primary and secondary creep, the tests were interrupted, the specimens air cooled and changes in subgrain size and of misorientation across sub-boundaries, from those of a light dislocation tangle appearing during primary creep to those which display Moiré fringes in secondary creep. While the subgrain size continuously decreases during the second stage from the annealed value of 60μ to 2μ, the misorientation, as measured by splitting in the Kikuchi line patterns, increases from 0.04 to 0.14 degrees. A comparison of the dislocation interactions during primary creep with the tangling theory of sub-boundary formation of Wilsdorf is presented. Author (NSA)

N68-23000# Commissariat a l'Energie Atomique, Saclay (France).

CONDITIONS FOR THE EXISTENCE OF LAVES PHASES IN INTERMETALLIC SYSTEMS [LES CONDITIONS D'EXISTENCE DES PHASES DE LAVES DANS LES SYSTEMES INTERMETALLIQUES]

Bernard Del Litto Nov. 1967 25 p refs In FRENCH; ENGLISH summary
(CEA-BIB-92) CFSTI: HC $3.00/MF $0.65

Among the intermetallic compounds possible in binary systems, the Laves phases cover a wide range. The size factor and the electron concentration play a predominant role in the formation of these phases, but they cannot account for the existence and the crystal structure of all Laves phases. Despite its empirical character, the classification of Dwight provides a justification for the crystal structures encountered in the pseudo-binary alloys. Such a classification seems to be supported by the general theory recently proposed by Brewer. Author

N68-23002# Commissariat a l'Energie Atomique, Saclay (France).

EFFECT OF HIGH HYDROSTATIC PRESSURES ON THE SELF-DIFFUSION OF γ URANIUM AND THE NOBLE METALS [INFLUENCE DES PRESSIONS HYDROSTATIQUES ELEVEES SUR L'AUTODIFFUSION DE L'URANIUM γ ET DES METAUX NOBLES]

Michel Beyeler, Bernard Pernot, and Yves Adda Oct. 1967 29 p refs In FRENCH
(CEA-R-3316) CFSTI: HC $3.00/MF $0.65

The experiments were made on polycrystalline γ uranium and on noble metals single and polycrystalline. The behavior of single crystals under pressure is normal and leads to activation volumes of diffusion in good agreement with the theoretical evaluations. Though polycrystalline materials present an anomaly of diffusion under pressure, the experiments at very high pressure lead to activation volumes close to those measured on single crystals. The activation volume thus evaluated for γ uranium is in good agreement with a vacancy diffusion mechanism. Author

N68-23005# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.

EXPERIMENTAL CONFIRMATION OF THE LIFSHITZ-WAGNER THEORY OF PARTICLE COARSENING

A. J. Ardell Feb. 1968 28 p refs *Its* Res. and Develop. Rept. No. 54

(Contract AT(04-3)-221)

(CALT-221-39) CFSTI: HC$3.00/MF$0.65

Various aspects of the Lifshitz–Wagner theory of particle coarsening are examined using data on the γ' precipitate in binary Ni-base alloys of Al, Ti, and Si. The kinetics of growth of the average particle, the experimental distributions of particle sizes, and the variation with time of the average solute concentration of the matrix are all demonstrated to be in excellent quantitative agreement with the predictions of the Lifshitz–Wagner theory. A small discrepancy between the experimental and theoretical values of the cut-off particle size (the largest particle size observed in the distribution) is briefly discussed. A kinetic equation for the variation of the volume fraction γ' during coarsening is presented. Data on the Ni–Al system are used to illustrate the change in volume fraction that accompanies coarsening of the γ' precipitate. Author (NSA)

N68-23019# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France).

REACTION OF URANIUM AND PLUTONIUM CARBIDES WITH AUSTENITIC STEELS [REACTION DES CARBURES D'URANIUM ET DE PLUTONIUM AVEC DES ACIERS AUSTENITIQUES]

Michel Mouchnino Oct. 1967 38 p refs In FRENCH

(CEA-R-3353) CFSTI: HC$3.00/MF$0.65

The reactions were studied between 650° and 1050°C using UC, steel and (UPu)C, and steel diffusion couples. The steels are of the type CN 18.10 with or without addition of molybdenum. The carbides used are hyper-stoichiometric. Tests were also carried out with UCTi, UCMo, UPUCTi and UPuCMo. Up to 800°C no marked diffusion of carbon into stainless steel is observed. Between 800° and 900°C the carbon produced by the decomposition of the higher carbides diffuses into the steel. Above 900°C, decomposition of the monocarbide occurs according to the reaction $(U,Pu)C + (Fe,Ni,Cr) \rightarrow (U,Pu)Fe_2 + Cr_{23}C_6$. Above 950°C the behavior of UPuCMo and that of the titanium (CN 18, 12) and nickel (NC 38.18) steels is satisfactory. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N68-22017# Royal Aircraft Establishment, Farnborough (England).

STUDIES ON CARBONIZATION OF POLYACRYLONITRILE FIBRE. PART 5: CHANGES IN STRUCTURE WITH PYROLYSIS OF POLYACRYLONITRILE FIBRE

Kazuo Miyamichi, Masao Okamoto, Osamu Ishizuka, and Masamichi Katayama Dec. 1967 23 p refs Transl. into ENGLISH from J. Soc. Fibre Sci. and Tech., Japan, v. 22, no. 12, 1966 p 538–547

(RAE-LIB-TRANS-1272)

Polyacrylonitrile fibres were heated to 200°C–250°C in an inert atmosphere in a vacuum and in air. The changes in molecular structure were then examined by means of X-ray diffraction, infra-red spectroscopy, electron spin resonance, chemical analysis and measurements of solubilities and of the amounts of hydrogen cyanide and ammonia formed. The results indicated that two types of cyclic system could occur and co-exist in the heated fibres. One system which was predominant in fibres heated in air was thought to have a plane sheet-like configuration that could be arranged to form crystallites. The other system however, predominating in fibres heated in the inert atmospheres, was suggested to have a twisted structure that could not easily form crystallites. The solubility measurements indicated that inter-molecular crosslinking occurred only in oxidizing atmospheres. Author

N68-22018# Royal Aircraft Establishment, Farnborough (England).

STUDIES ON CARBONIZATION OF POLYACRYLONITRILE FIBRE. PART 6: CHANGE IN MOLECULAR STRUCTURE DURING CARBONIZATION PROCESS

Kazuo Miyamichi, Masao Okamoto, Osamu Ishizuka, and Masamichi Katayama Dec. 1967 11 p refs Transl. into ENGLISH from J. Soc. Fibre Sci. and Tech., Japan, v. 22, no. 12, 1966 p 548–551

(RAE-LIB-TRANS-1273) CFSTI: HC$3.00/MF$0.65

Polyacrylonitrile fibres, flame-proofed by heating in air at 300°C, were heat-treated in nitrogen at various temperatures up to 1000°C. They were then examined by X-ray diffraction, electron spin resonance and measurements of densities, electrical resistivities and the amounts of ammonia and hydrogen cyanide formed. The results are discussed in terms of two cyclic structures which are thought to co-exist in the flame-proofed fibre and which eventually decompose to form carbon at temperatures above 600°C. Author

N68-22039*# Commonwealth Scientific Corp., Alexandria, Va.

INVESTIGATION OF POLYMERIC COATINGS BY ELECTRODELESS DISCHARGE Final Report

J. P. Redmond and A. F. Pitas [1968] 41 p refs

(Contract NASw-1625)

(NASA-CR-94310) CFSTI: HC$3.00/MF$0.65 CSCL 11I

This program was divided into five phases. The first phase was the construction of a vacuum apparatus to deposit the films. The second phase was to deposit sufficient quantities of the films prepared from the four selected hydrocarbons to characterize these polymers. The third phase was to prepare polymers from the selected compounds after premixing them with hydrogen or deuterium in molecular ratios of 1/1, 2/1 and 4/1. The fourth phase was to investigate the structure of films prepared from toluene, trifluoroethylene and tetrafluoroethylene. The final phase was to evaluate the results of the study as to the nature of the film and to clarify as much as possible the deposition process. The net result from this study is that continuous, homogeneous, adherent plastic coatings can be vapor deposited via an electrical discharge. These films are very highly cross-linked, consequently, they possess good thermal and chemical stabilities. In addition they are nonpermeable and would exhibit low outgassing characteristics. Even more significant is the fact that the film can be tailored to meet specific applications. For example, one could initially deposit a film from ethylene and then gradually switch the gas composition to deposit a Teflon-like film from tetrafluoroethylene with no demarcation line. The chemical and thermal inertness of these films suggest they might find applications as nonpermeable coatings in fuel storage containers. Author

N68-22067# General Electric Co., Schenectady, N. Y. Research and Development Center.

FLAMMABILITY OF EPOXY RESINS

F. J. Martin and K. R. Price Jun. 1967 24 p refs

(Rept.-67-C-232)

Flammability determinations have been made for epoxy resin formulations. The oxygen index, defined as the volume fraction of oxygen in an oxygen/nitrogen atmosphere that is required to just sustain steady candle-like burning of a stick of the material, has been used as the measure of flammability. The formulations selected for study were those for which the chemical composition of the ingredients was known at least approximately and for which uniform cast slabs (1/8 inch thick) could be readily prepared. They covered a range of compositions of commercial interest. The results have been interpreted in terms of a proposed model for candle-like burning. Effects due to resin composition, cure conditions, fillers, and flame-retardant additives are discussed. Author

N68-22107 Rensselaer Polytechnic Inst., Troy, N. Y.

THE ROLE OF PLASTIC FLOW BY DISLOCATION MOTION IN THE SINTERING OF CALCIUM FLUORIDE

Ashok Ramchand Hingorany (Ph.D. Thesis) 1966 99 p

Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-4171

Sphere on plate model experiments were performed to study the contribution made by plastic flow to the sintering of calcium fluoride. Spheres of calcium fluoride with a fine dispersion of stabilized zirconia as markers were sintered at various temperatures and for various times on a plate, which also contained stabilized zirconia markers with or without an external load. After sintering, the samples were sectioned, polished and photographed to determine the position of the markers in the neck region. Samples without an external weight initially showed markers up to the very end of the neck, but with increasing neck size a region without markers at the end of the neck was observed. The photomicrographs of the samples sintered under identical conditions with an external load showed that the necks of the samples always had markers up to the end. It is concluded that material transport by plastic flow takes place during the early stage of sintering which switches to a diffusional flow. Dissert. Abstr.

N68-22162# European Space Technology Center, Delft (Netherlands).

EFFECTS OF GAMMA RADIATION ON CERTAIN SYNTHETIC LUBRICANTS [EFFECTS DES RAYONNEMENTS GAMMA SUR CERTAINS LUBRIFIANTS SYNTHETIQUES]

J. Dauphin and M. Ladous Paris ESRO Aug. 1967 23 p refs In FRENCH; ENGLISH summary

(ESRO-TM-100) CFSTI: HC$3.00/MF$0.65

Studies were conducted to ascertain the effects of γ radiation on certain fluorinated and silicone oils. The results are only partial ones, quoted from memory, as the work was cut (and the reports and samples destroyed) by the ESTEC fire. For the same reason, the conclusions have an element of uncertainty about them. Fluorolube oils gave good results for both gas evolution and viscosity variation. The acidity they develop may, however, prove very harmful; and this aspect merits more detailed study. Author (ESRO)

N68-22264 Lockheed Missiles and Space Co., Palo Alto, Calif.

INFLUENCE OF NONEQUILIBRIUM OF THE DECOMPOSITION ON THE THERMAL MODE OF COMPOSITE COATINGS

Iu. A. Dushin, N. V. Makarov, and M. S. Naumov [1968] 3 p refs Transl. into ENGLISH from Inzh. Fiz. Zh., Akad. Nauk Belorussk. SSR (USSR), v. 13, no. 6, 1967 p 884–886

Based on the use of equilibrium parameters, a method is described for computing the decomposition rate of a composite coating consisting of a refractory facing and a low heat-conductive substrate. It is assumed that the gases formed during heating of the substrate create a layer with high heat resistivity, thereby increasing the facing temperature and decreasing the external thermal loading. Consideration is given to a complex general case for which it is impossible to predict the decomposition mode, such as the use of inorganic sublimators NH_4Cl and NH_4HS as substrates. M.G.J.

N68-22344* North American Rockwell Corp., Anaheim, Calif. Autonetics Div.

EFFECTS OF DECONTAMINATION AND STERILIZATION ON SPACECRAFT POLYMERIC MATERIALS

S. M. Lee and J. J. Licari 12 Jan. 1968 304 p refs Prepared for JPL

(Contract NAS7-100)

(NASA-CR-94312; C8-58/501) CFSTI: $3.00 CSCL 11I

The effects of ethylene oxide decontamination and the combined effects of ethylene oxide decontamination and thermal sterilization on approximately 180 various spacecraft polymeric materials are discussed. The materials in the twenty different material categories chosen for this study were subjected to the decontamination and sterilization procedures. This included six separate cycles of ethylene oxide decontamination for 30 hours/cycle at 50°C at 50% relative humidity. Samples were then removed for physical testing and the remaining samples were then exposed to six additional and separate cycles of thermal sterilization at 135°C for 96 hours/cycle in dry nitrogen. Author

N68-22391*# General Electric Co., Philadelphia, Pa.

COATING SELECTION PROGRAM: THEORY

Frederick A. Costello, Thomas P. Harper, and Barbara Aston Washington NASA Apr. 1968 48 p refs

(Contract NASw-960)

(NASA-CR-1041; Doc.-65SD526) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A rational and direct method has been developed for selecting the optical coating pattern for the external surface of a spacecraft, such that the spacecraft temperatures are as close as possible to the midpoint of their preselected ranges. The temperature control is maintained passively by radiation and conduction, using no active control devices. The complete range in mission environments is considered in the optimization procedure. The selection technique has been programmed for use on the GE 600 Series, IBM 7094, or any other computer that uses the standard IBM Fortran IV system. Author

N68-22485# Union Carbide Corp., Parma, Ohio. Carbon Products Div.

EFFECTS OF NEUTRON DAMAGE ON THE MECHANICAL PROPERTIES OF PYROLYTIC AND SINGLE-CRYSTAL GRAPHITE Scientific Report, 1 Apr. 1964–30 Jun. 1967

J. T. Meers 6 Sep. 1967 76 p refs

(Contract AT(40-1)-3237)

(TID-24233) CFSTI: HC$3.00/MF$0.65

The elastic constants of pyrolytic graphite which has been highly ordered by annealing under compressive stress have been determined by ultrasonic, sonic resonance, and static test methods, and the shear modulus of natural graphite crystals was determined by ultrasonic and static shear tests. Neutron irradiations were carried out at exposures of 3 to 71×10^{17} nvt at 50°C, at exposures of 3 to 8×10^{19} nvt at 650°C, and at an exposure of 1.2×10^{20} nvt at 1000°C. The only elastic constant which changed significantly with irradiation was the shear modulus. The changes in shear modulus upon irradiation for the pyrolytic graphite and natural crystals are interpreted in terms of the homogeneous nucleation theory of Reynolds and Thrower, which is based on electron microscope observations on irradiated graphite crystals. Author (NSA)

N68-22541# Arizona Univ., Tucson. Dept. of Chemistry.

KINETICS OF SECONDARY REACTIONS IN IRRADIATED POLYETHYLENE Final Report, 1 May 1966–31 Aug. 1967

David M. Bodily 2 Feb. 1968 21 p refs

(Contract AT(11-1)-1614)

(COO-1614-1) CFSTI: HC$3.00/MF$0.65

Chemical reactions occurring in polyethylene and other polymers during and subsequent to irradiation with ionizing radiation were studied to determine the mechanisms of these reactions. The decay of vinyl and vinylene groups was markedly suppressed at low temperatures. The rate of decay at 77°K was about 48% the rate at 298°K. The rate of decay of these groups was also reduced for irradiations of greater linear energy transfer. For proton irradiations, the rate was about 34% of the rate for electron or gamma irradiations. For alpha particle irradiations, the rate was about 18% of the rate for gamma irradiations. The rate of formation of vinylene and vinyl groups was only slightly affected by temperature, linear energy transfer, or phase. In cis-polybutadiene, the rate of cis-trans isomerization was nearly independent of temperature, but the rate of disappearance of unsaturation at 77°K was only 42% of the rate at 298°K. Author (NSA)

N68-22548# Purdue Univ., Lafayette, Ind. Dept. of Physics.
MOESSBAUER, X-RAY, AND CHEMICAL STUDIES OF COBALTOUS OXIDE
Hang Nam Ok [1967] 166 p refs
(Contract AT(11-1)-1616)
(COO-1616-5) CFSTI: HC$3.00/MF$0.65

Hyperfine Moessbauer spectra were analyzed for CoO(I), CoO(II), and CoO(I,II). A general formalism was developed for H, $e^2qQ/2$, θ, ϕ, and η from Moessbauer data by diagonalizing the interaction matrix related to the first excited state of ^{57}Fe nuclei. The chemical composition is shown to be very important in all studies. NSA

N68-22689# Georgia Univ., Athens. Dept. of Physics.
INFRARED SPECTRA OF PLASTICS AND ELASTOMERS AFTER NUCLEAR IRRADIATION Research Report, 1967
W. C. Sears 19 Dec. 1967 22 p refs
(Contract AT(40-1)-2418)
(ORO-2418-4) CFSTI: HC$3.00/MF$0.65

Since molar absorptivity for the trans-vinylene band in trans-1,4-polybutadiene was found to change with temperature, a study of it was begun to determine applicable absorptivities for analysis or irradiated polymers whose spectra were measured at high temperatures to eliminate crystallinity. Molar absorptivity dropped sharply at 46°C in changing from crystalline modification I to II. Applicable trans-vinylene absorptivities for analyzing irradiated Neoprenes may be evaluated from the Neoprene polymers themselves or from values obtained from trans-1,4-polybutadiene. Different O-ring polymers were tested to improve their permanent set and hot extrusion which resulted in gasket leaks around the salt windows on cooling the helium-filled absorption cells to room temperature. Viton-A and live silicone rubber O-rings spring loaded to compensate for plastic flow provided the most satisfactory solution. A dose of 18×10^8 RAD produced strong new bands in poly-2-vinylpyridine at 2350, 2068, 2000, 1618, and 1536 cm^{-1}. The 2068 and 2000 cm^{-1} bands suggest formation of allenes. None of these new bands were found in the 75/25 butadiene/2-methyl-5-vinylpyridine copolymer after irradiation. The radioinduced changes in the copolymer after doses up to 9.8×10^8 RAD appeared to be confined to the butadiene fraction. Author (NSA)

N68-22696# Olin Mathieson Chemical Corp., New Haven, Conn. Organic Research Dept.
DEVELOPMENT OF FLEXIBLE EPOXY RESINS AND COATINGS Final Report, 1 Mar. 1967–29 Feb. 1968
S. Venkataramaraj Urs and Salvatore A. Puglia 29 Feb. 1968 37 p ref
(Contract N00019-67-C-0295)
(AD-666293) CFSTI: HC$3.00/MF$0.65

Coatings with excellent low temperature flexibility were made by blending 20 parts polyether diepoxide DER 732 and 80 parts aromatic epoxy resin epon 1001 and curing with polyether diamine POPDA 400. Also coatings with good flexibility at −45°F, high adhesion and abrasion resistance were prepared from moisture-set polytetramethylene glycol/TDI polyurethanes. However, these coatings needed long curing times. Epon 828 cured with polyether diamine POPDA 400 and polyether triamine PPE 640TA gave coatings with good gloss and high abrasion resistance. But, the coatings had only marginal low temperature properties. Anticipated high temperature resistant coatings were not realized from oxydiphenol epoxy resins. Also, the resins had poor solubility properties. A urethane-epoxy hybrid coatings was synthesized which should have low temperature flexibility of urethane polymers and the fast curing rate of epoxy resins. Author (TAB)

N68-22707*# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.
SEPARATOR DEVELOPMENT PHASE OF HEAT-STERILIZABLE BATTERY DEVELOPMENT PROGRAM: BATTERY CASE DEVELOPMENT Final Report, 10 Apr. 1967–31 Jan. 1968
15 Feb. 1968 14 p Prepared for JPL
(Contracts NAS7-100; JPL-951091)
(NASA-CR-94353) CFSTI: HC$3.00/MF$0.65 CSCL 11J

The objective of this program was the development of an injection-moldable polymer suitable for use as the case in heat sterilizable batteries. The polybenzimidazole studied, which was based on diamino-benzidine and sebacic acid (PBI-8), met all of the preliminary requirements for the battery case. Some bonds were made with the aid of epoxy adhesives. Solvent welding was found to be the best method to join the PBI-8 polymer. A capped PBI-8 was extruded and injection molded. A number of injection-molded tensile specimens were prepared and tested. Author

N68-22823# Wisconsin Univ., Madison.
ANALYTICAL PROCEDURES FOR PREDICTING THE MECHANICAL PROPERTIES OF FIBER REINFORCED COMPOSITES, PART 3 Summary Report, 1 Aug. 1966–1 Aug. 1967
Gerald Pickett and Millard W. Johnson, Jr. Wright-Patterson AFB, Ohio AF Mater. Lab. 1 Oct. 1967 40 p refs
(Contract AF 33(615)-2030)
(AFML-TR-65-220, Pt. 3; AD-666054)

The stress concentration near a break in a long elastic fiber in an elastic matrix is analyzed. The analysis is based upon the mathematical theory of elasticity for both materials. The investigation shows that both the magnitude of the stress concentration factor and the rate of concentration as the discontinuity is approached depend on the relative elastic properties of the two materials. Author (TAB)

N68-22828# Iowa State Univ. of Science and Technology, Ames.
THERMAL EXPANSION OF THE SESQUIOXIDES OF YTTRIUM, SCANDIUM, AND GADOLINIUM
Denzil Wayne Stacy (M.S. Thesis) Nov. 1967 45 p refs
(Contract W-7405-ENG-82)
(IS-T-212) CFSTI: HC$3.00/MF$0.65

Linear thermal expansion measurements of the sesquioxides of yttrium, scandium, and gadolinium were made from room temperature to 1100°C with a sapphire-rod dilatometer. Dilatometer design and calibration were described. Expansion measurements were made on both the monoclinic and cubic forms of gadolinia. Purity, firing conditions, and apparent density of the specimens were reported. The over-all coefficients of linear thermal expansion from 25 to 1100°C were found to be 7.93×10^{-6} in./in. °C for yttria, 8.54×10^{-6} in./in. °C for scandia, 9.49×10^{-6} in./in. °C for monoclinic gadolinia, and 7.61×10^{-6} in./in. °C for cubic gadolinia. Results were compared with those obtained previously. Author (NSA)

N68-22843*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
EXPERIMENTAL INVESTIGATION OF ULTRAHIGH VACUUM ADHESION AS RELATED TO THE LUNAR SURFACE Quarterly Progress Report, 1 Jan.–30 Apr. 1968
J. A. Ryan and J. J. Grossman 30 Apr. 1968 33 p
(Contract NAS7-307)
(NASA-CR-94426; QPR-14) CFSTI: HC $3.00/MF $0.65 CSCL 11B

This report presents the results of studies on the ultrahigh vacuum adhesional behavior of silicates. Work consisted of contacting ultrahigh vacuum cleaved silicate surfaces with argon ion sputtered metal surfaces, and investigation of the mechanisms responsible for the considerable electrostatic charging of silicates produced by ultrahigh vacuum cleavage. It was found that adhesion between the sputtered metal and cleaved silicates did occur, the measured adhesion force being about 10^2 dynes after touch contact. It appears that the primary if not sole contributor to this adhesion is the electrostatic charging of the silicate, but much more work is required to determine the precise effect of metal surface state. The electrostatic charging studies further verified the highly anisotropic nature of the charging. The also demonstrated that massive breakdown in the charge anisotropy occurs as system pressure is increased and that recovery can occur. Photomicrographic study of the cleaved surfaces (before and after defect etching) and electron microprobe analysis reveal a close correlation between the charge and composition gradient profiles. This indicates strongly that the primary contributor to the charging and charge anisotropy in the crystals studied to date is the polarization field associated with the composition gradients. Author

N68-22892# Sandia Corp., Albuquerque, N. Mex.
AN EVALUATION OF MICROWAVE WINDOW MATERIAL AND ABLATION MATERIAL ASSEMBLIES IN SIMULATED RE-ENTRY ENVIRONMENTS
Keith E. Mead Dec. 1967 63 p refs
(Contract AT(29-1)-789)
(SC-DR-67-793) CFSTI: HC $3.00/MF $0.65

Dielectric materials suitable for reentry thermal protection of microwave antennas have been built into models of window-ablator combinations. These models have been subjected to simulated re-entry environments in ground test facilities to determine window-ablator compatibility, window thermal excursion rates, and the integrity of window-ablator assembly techniques. Windows tapered for retention and a close fit between window and surrounding ablator were found to be a superior assembly technique. The surface recession of silica and isotropic pyrolytic boron nitride windows closely follows that of the phenolic–carbon ablation material used in these tests. Anisotropic pyrolytic boron nitride stands in relief when used with phenolic–carbon ablator. No serious delamination problems were encountered with anisotropic pyrolytic boron nitride when properly machined and assembled. Author (NSA)

N68-22949# Sandia Corp., Albuquerque, N. Mex.
SOME DYNAMIC MECHANICAL PROPERITES OF PYROLYTIC BORON NITRIDE
Larry M. Lee Dec. 1967 22 p refs
(Contract AT(29-1)-789)
(SC-RR-67-2947) CFSTI: HC $3.00/MF $0.65

Data are presented for the response of 2.18 gm/cc pyrolytic boron nitride (PBN) to impacts producing up to 24 kbar pressure. A linear, rate insensitive, relation between the stress-wave velocity and the particle velocity is observed in this range. The function dependence is $U_s = 2.56 + 3.84\ u_p$ mm/μsec. Uniaxial stress compression and tension test data are also presented. The compression tests were for strain rates up to 10^3 in./in./sec and the tension tests were to rates of 5 in./in./sec. Author (NSA)

N68-23022# Uniroyal Research Center, Wayne, N. J.
DEVELOPMENT OF A MULTIDIRECTIONAL-STRETCH SPACER FABRIC
M. W. Olson, A. S. Glowacki, and R. A. Fowkes Natick, Mass. Clothing and Organic Mater. Lab. Dec. 1967 33 p
(Contract DA-19-129-AMC-1069(N))
(TR-68-34-CM; AD-666804)

An investigation was conducted to develop a 3-dimensional spacer fabric for use in the air distribution system of the experimental thermalibrium protective clothing system designed by the U. S. Army Natick Laboratories. A multidirectional-stretch spacer fabric known as monocoil made by interlocking coiled monofilaments in a square woven fabric-like configuration, was selected as the candidate system. A variety of materials were studied. Based on analysis of available monofilaments, polyester was chosen as the material to be used in the construction of this 3-dimensional fabric. Numerous monocoil designs were fabricated and tested for air flow, compression, weight, and stretch characteristics. A construction which met specifications was selected for quantity production. Two-hundred linear yards of experimental spacer fabric 42-48 inches wide were manufactured. During development, it was found necessary to apply a protective or restraining cover to control stretch and enable handling of the spacer fabric. Cover materials included high-stretch power net, Jersey-knit Nomex fabric, and neoprene sheeting. Author (TAB)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N68-21850 Ohio State Univ., Columbus.
MEAN VALUE PROPERTIES OF GENERALIZED MATRIX FUNCTIONS
Paul John Nikolai (Ph.D. Thesis) 1966 66 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-6351

Applications are provided which furnish new inequalities for generalized matrix functions, the permanent, and the determinant. Dissert. Abstr.

N68-21882 Purdue Univ., Lafayette, Ind.
SOME CHARACTERIZATIONS FOR THE DIFFERENTIABILITY AND FRACTIONAL DIFFERENTIABILITY OF FUNCTIONS
Grant Vincent Welland (Ph.D. Thesis) 1966 85 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-5512

Suppose there exists a polynomial $Q_{x_o}(t)$ of degree less than or equal to k-1 such that $f(x_o+t) + (-1)^{k+1} f(x_o-t) - Q_{x_o}(t) = \epsilon_{x_o} t^k/k! = 0(t^k)$ as $t \to o$, then f is said to satisfy Λ_k at x_o. It is shown that a necessary and sufficient condition for f to have a k-th Peano derivative almost everywhere in a measurable set E is that for almost every x in E there is an $\eta_x = \eta > 0$ such that the integral is finite. It is also shown that f has a k-th Peano derivative almost everywhere in a measurable set E if and only if for almost every x in E there is an $\eta_x = \eta > 0$ such that the sequence is bounded. Dissert. Abstr.

N68-21886 Purdue Univ., Lafayette, Ind.
VARIATION CONVERGENCE FOR BERNSTEIN POLYNOMIALS
Martin Edward Price (Ph.D. Thesis) 1966 61 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-5486

Let B_nf denote the n-th Bernstein polynomial of a real function f defined on [0,1] and VB_nf be its total variation. It is known that if f is of bounded variation on [0,1], then VB_nf tends to V_of, where V_of is the variation of f taken over points of continuity. Since B_nf depends only on the rational values of f, the concepts of bounded variation and continuity are inappropriate to sufficiently describe the variation behavior of Bernstein polynomials. Consequently, instead of functions, we consider "skeletons," i.e., functions defined only on the rationals. We give conditions that can be imposed on the skeletons f in order that VB_nf will converge to zero. We also show, by examples, that there are highly irregular skeletons for which VB_nf tends to zero, and high regular skeletons (in the sense of uniform convergence) for which VB_nf goes to ∞ for a subsequence $\{n_k\}$. Dissert. Abstr.

N68-21978*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ON THE CONSTRUCTION OF HIGHLY STABLE, EXPLICIT, NUMERICAL METHODS FOR INTEGRATING COUPLED ORDINARY DIFFERENTIAL EQUATIONS WITH PARASITIC EIGENVALUES

Harvard Lomax Washington Apr. 1968 46 p refs
(NASA-TN-D-4547) CFSTI: HC$3.00/MF$0.65 CSCL 12A

A theory is developed for constructing explicit numerical methods for integrating coupled nonlinear ordinary differential equations with local eigenvalues that are greatly separated in magnitude. Applications are made to cases in which large negative eigenvalues are combined with small complex ones. The specific methods derived are compared with Runge-Kutta methods. The derived methods are not considered to be optimum and further improvements are anticipated. Author

N68-22025*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.

CONDITIONS FOR ASYMPTOTIC STABILITY OF THE DISCRETE, MINIMUM VARIANCE, LINEAR ESTIMATOR

John J. Deyst, Jr. and Charles F. Price Mar. 1968 14 p refs
(Grant NGR-22-009-207)
(NASA-CR-94292; RE-41) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Stability of the discrete, homogeneous, linear, minimum variance estimation formulas is investigated. Sufficient conditions for uniform asymptotic stability in the large are derived. The conditions, if satisfied, also imply stochastic controllability and observability of the plant. Author

N68-22041*# Lehigh Univ., Bethlehem, Pa. Inst. of Research.

APPROXIMATE SOLUTION OF SYSTEM OF SINGULAR INTEGRAL EQUATIONS

Fazil Erdogan [1968] 29 p refs
(Grant NGR-39-007-011)
(NASA-CR-94170) CFSTI: HC$3.00/MF$0.65 CSCL 12A

Using the properties of the related orthogonal polynomials, approximate solution of a system of simultaneous singular integral equations is obtained, in which the essential features of the singularity of the unknown functions are preserved. In the system of integral equations of first kind, the fundamental solution is the weight function of the Chebishev polynomials of first or second kind. In the system of singular integral equations of second kind with constant coefficients, the elements of the fundamental matrix are the weights of Jacobi polynomials. The approximate solution is expressed as the fundamental function, representing the singular behavior of the unknown functions, multiplied by series of proper orthogonal polynomials with unknown coefficients. The techniques of deriving the system of algebraic equations to determine these coefficients is described. Author

N68-22072 Florida Univ., Gainesville.

SEQUENTIAL STATE AND PARAMETER ESTIMATION IN DISCRETE NONLINEAR SYSTEMS

George Windsor Masters, Jr. (Ph.D. Thesis) 1966 148 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-3483

The work presented in this dissertation derives a sequential method for on-line estimation of the state variables and parameters of discrete, non-linear, dynamical systems. A discrete version of Pontryagin's Maximum Principle is employed to obtain the canonic equations of the least-squares optimal estimator. A discretized invariant imbedding technique is then applied to solve the resulting two-point boundary value problem. Finally, a system of sequential equations is obtained by application of variational methods to the optimal trajectory. The result is a sequential estimation scheme conceptually related to existing methods developed for continuous systems. The method presented has the advantage of direct applicability to discrete systems and provides for the inclusion of higher-order terms not usually considered by other methods. As a result of these inherent features, the process has been found to provide a faster, more stable estimate of the system variables. In addition, a minimum of a-priori statistical information is required. Dissert. Abstr.

N68-22084 City Univ. of New York.

EXTREMA CONCERNING ASYMMETRIC GRAPHS

Louis V. Quintas (Ph.D. Thesis) 1966 57 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-6395

Questions pertaining to the existence, structure, and enumeration of asymmetric graphs are investigated; and extreme values are established for *p* and *q* for which there exist asymmetric graphs having *p* vertices and *q* edges. These extremes are obtained for all graphs and for connected graphs, graphs without vertices of degree 2 or topological graphs, and connected topological graphs. The simple structure of asymmetric topological graphs having two independent cycles is shown, and this permits enumeration of the graphs. Dissert. Abstr.

N68-22101 California Univ., Berkeley.

STABLE SMOOTHINGS ON TOPOLOGICAL MANIFOLDS

Allen Usher Brender (Ph.D. Thesis) 1966 52 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-5009

Let M^n be a topological n-dimensional manifold without boundary. A stable smoothing of M^n is a smoothing of $M^n \times R^k$ for some $k \geq 0$. An equivalence relation, stable concordance, is defined on the collection of stable smoothings of M^n. $\Delta(M)$ is the set of equivalence classes. Two stable smoothings which represent the same element of $\Delta(M)$ are stably diffeomorphic. Our principal result is a classification of $\Delta(M)$ in homotopytheoretic terms. $\Delta(M)$ is in one-one correspondence with equivalence classes of reductions to the orthogonal group of the stable tangent bundle of M^n. If M^n is compact, $\Delta(M)$ is in one-one correspondence with [SM, Top/O]; SM is the singular complex of M and all maps are semi-simplicial. Dissert. Abstr.

N68-22146 Maryland Univ., College Park.

APPROXIMATION TOPOLOGIES ON OPERATOR SPACES

Peter Jules Richetta (Ph.D. Thesis) 1966 62 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-6131

Approximations of continuous, weakly compact, and compact linear mappings of the locally convex space X into Y were studied by transformations of finite dimensional range. The general linear continuous map is approximated in a topology of convergence on convergent filters in X. For Banach spaces the weakly compact maps are approximated in the topology of uniform convergence on bounded subsets of X using the weak topology on the range. The least upper bound of the latter topology, and the topology of almost uniform convergence on the unit ball of X using the norm topology on Y, is an approximating topology for compact mappings of Banach spaces. Some of the approximations are strict in the sense that no other continuous or linear transformations are approximated. If the original operator space topology is generated by using the weak topology on Y, the operator space weak topology can be expressed in terms of almost uniform convergence on subsets of X. Dissert. Abstr.

N68-22174 Michigan Univ., Ann Arbor.

ON PRIMITIVE FROBENIUS GROUPS

Raymond Terry Czerwinski (Ph.D. Thesis) 1966 115 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-1722

The purpose of this thesis is to give a classification of the primitive Frobenius groups. The investigation of these groups is important in light of the role played by Frobenius groups in recent results in group theory. The importance of these groups also rests on the well known relationship between finite projective planes and fixed point free automorphisms of elementary abelian groups. A fresh exposition is given of the classification of the primitive Frobenius groups considered as abstract groups. The representations of these groups that are faithful and without eigenvalue 1 are given. The problem of extending the Frobenius Reciprocity Theorem to representations that are irreducible, but not necessarily absolutely irreducible is considered. A few problems in the theory of finite permutation groups are taken up. In particular, the rank 3 primitive Frobenius groups are classified. Dissert. Abstr.

N68-22179 California Univ., Los Angeles.

QUANTIZATION IN CLIFFORD SPACE-TIME AND PROBLEMS IN GROUP THEORY, PARTS 1 AND 2

Daniel Lee Wenger (Ph.D. Thesis) 1966 128 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-4471

Discussed are problems of quantization in a space-time which has the properties of zero curvature and uniform torsion and which approaches Minkowski space as the torsion vanishes. Specifically, we find the solutions to the Klein–Gordon equation and the Dirac equation in this space, a special property of these solutions being that they are normalizable. The space-time in question is shown to be compatible with a cosmological model based on Einstein's equations where the energy-momentum tensor is that of the ground state of a system of fermions. The study of SU_n is extended to include the determination of particular root vectors and fundamental weights. The root vectors are chosen so as to show explicitly the canonical nesting of subgroups. The results are all dependent upon the use of n vectors which define the fundamental region of SU_n A simple method is discussed for finding a closed form expression for finite matrix transformations when the infinitesimal generator is given. The result is given in terms of the diagonalized elements of the generator. Dissert. Abstr.

N68-22187 California Univ., Riverside.

EXTENSIONS OF A. T. CRAIG'S GENERALIZATION OF PROPERTY L

Norman Francis Robinson (Ph.D. Thesis) 1966 46 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-5862

We have investigated collections of matrices or linear operators which satisfy polynomial or power series conditions similar to property L. Our investigations began with the unpublished theorem of A. T. Craig. In Chapter I we give a proof of Craig's Theorem due to H. T. Muhly, and in Chapter II, using an adaptation of Muhly's proof, we extend Craig's Theorem to normal matrices. We also replace the polynomials occurring in Craig's Theorem by power series. In Chapter III, using adaptations of the techniques of Muhly and Kaplansky, we obtain several partial generalizations of Craig's Theorem and the results of Kaplansky for normal compact operators on a Hilbert space. Dissert. Abstr.

N68-22203*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

TWO NOTES ON PERTURBATION THEORY. 1: INTERCHANGE THEOREMS AND THE VARIATION PRINCIPLE. 2: PV IN A DIFFERENT NOTATION

Saul T. Epstein 19 Feb. 1968 8 p refs
(Grant NsG-275-62)
(NASA-CR-94333; WIS-TCI-286) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The common origin of interchange theorems in the Rayleigh–Schroedinger perturbation theory and in the perturbation theory within the Hartree–Fock approximation is proven and extended to other situations by showing how interchange theorems arise out of the variational principle. G.G.

N68-22206 California Univ., Berkeley.

REPRESENTATION OF ACCRETIVE BILINEAR FORMS IN HILBERT SPACE BY MAXIMAL ACCRETIVE OPERATORS

Alan Gaius Ramsay McIntosh (Ph.D. Thesis) 1966 56 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-5111

Let D be a dense linear manifold of a Hilbert space H. A bilinear form J in H with domain $D(J) = D$ is defined to be a map from $D \times D$ to the complex plane that is linear in the first variable and semi-linear in the second variable. The operator A_J associated with J is the operator with largest domain satisfying $J[u,v] = (A_J u,v)$ for all $v \epsilon D(J)$. If J is accretive ($\mathrm{Re}\, J[u,u] \geq 0$, $u \epsilon D(J)$), then A_J is accretive ($\mathrm{Re}(A_J u,u) \geq 0$, $u \epsilon D(A_J)$). An accretive form J is defined to be representable if A_J is maximal accretive. This implies that the spectrum of A_J is contained in the right half of the complex plane. Our aim is to give conditions on J under which J is representable. It is clear that a bounded accretive form on H is representable. In the thesis, this theorem is generalized to the case of accretive forms that are not necessarily regularly accretive. This is achieved, first by proving two general representation theorems, and then by introducing the class of *closed accretive forms and showing that such forms are representable. Dissert. Abstr.

N68-22241 Purdue Univ., Lafayette, Ind.

FUNCTIONS OF TRANSITION FOR CERTAIN KAEHLER MANIFOLDS

Carl Theodore Verhey (Ph.D. Thesis) 1966 54 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-5510

If G is a $(2n+p) \times (2n+p)$ matrix, G^1 is to be the $(2n+p) \times (2n+p)$ matrix whose i,α^{th} (resp. α,i^{th}) component is $G_{i\alpha}$ (resp. $G_{\alpha i}$) for $i=1$, ---,2n; $\alpha=2n+1$, ---,$2n+p-1$, and whose remaining entries vanish, and G' is to be the transpose of the matrix G. Let M be a Kahler manifold which admits an isometric imbedding and A_m denotes the orthogonal $(2n+p) \times (2n+p)$ matrix defining the relationship between the vector fields and the natural orthonormal coordinate vector fields on E^{2n+p}. A compact analytic manifold M is an algebraic manifold if and only if it admits a Hodge metric. If M is a 2n-dimensional manifold with Riemannian metric r, then r is the real part of a Kahler metric of a complex analytic structure on M if and only if it admits a differentiable isometric imbedding g onto a k-manifold. In case such a g exists, it is in fact a holomorphic isometry with respect to the natural Kahler metric and complex structure of g(M). Dissert. Abstr.

N68-22280# Royal Aircraft Establishment, Farnborough (England).

ON RADAR AMBIGUITY FUNCTIONS INCLUDING ANGLE AND ANGLE-RATE

P. W. James Oct. 1967 25 p refs
(RAE-TR-67266) CFSTI: HC$3.00/MF$0.65

Beginning with a suitable distance function between two signals, an ambiguity function is constructed whose variables are angle and angle rate as well as range and range rate. Some of its properties are exhibited and discussed. Author (ESRO)

N68-22287 Joint Publications Research Center, Washington, D. C.

GENERALIZATION OF INAGAKI'S THEOREM

I. G. Globenko *In its* Some Spec. Appl. of Cybernetic Tech. 6 May 1968 p 7–10 refs (See N68-22285 12-10)

A precise solution is obtained for the optimal growth trajectory of a single-product dynamic model for economics applications. The product developed, reserves per unit of work, consumption per unit of work per tme unit, and labor resources are considered by the model. M.W.R.

N68-22334 Florida Univ., Gainesville.

COMPACT TOPOLOGICAL LATTICES

Tae Ho Choe (Ph.D. Thesis) 1966 60 p

Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-3466

Kaplansky proved that a compact semi-simple topological ring is iseomorphic with a Cartesian direct sum of finite simple rings; this implies that any compact Boolean topological lattice is totally disconnected. It is shown without using any duality theorem that any compact Boolean topological lattice of finite codimension is totally disconnected. Although it turns out that the order and interval topologies in a lattice do not always yield topological lattices, it is nevertheless of interest to investigate conditions under which a given intrinsic topology does yield a topological lattice. Professor A. D. Wallace conjectured that the center of a compact connected topological lattice of dimension n contains at most k^n elements. In the last section of this paper another method of proving Wallace's conjecture will be demonstrated. A representation theorem of a topological lattice will also be considered. In addition, several structure theorems of compact topological lattices are proved. Dissert. Abstr.

N68-22351 Maryland Univ., College Park.

AN INTEGRAL IN TOPOLOGICAL SPACES

Vaclav Frantisek Pfeffer (Ph.D. Thesis) 1966 67 p

Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-6144

Let P be a locally compact Hausdorff topological space, $P \cup \{\infty\}$ its one-point compactification, and let σ be a ring of subsets of P, which contains all singletons $\{x\}$, where $x \epsilon P$. Further, let G be a non-negative finitely additive extended real valued function defined on σ. With every $x \epsilon P \cup \{\infty\}$ we shall associate a family H_x of nets $\{B_\alpha\} \subset \sigma$. For $A \epsilon \sigma$, A^- denotes the closure of A in P, and σ_A the family of all $B \epsilon \sigma$ for which $B \subset A^-$. Under a few hypotheses concerning σ, G and H_x, the integral I has all the pleasant properties which an integral is usually required to have. Moreover, the integral is in a certain sense closed with respect to the formation of improper integrals. There are several applications to concrete spaces, where the integral I turns out to be an actual generalization of the Lebesgue one. Dissert. Abstr.

N68-22515# General Electric Co., Philadelphia, Pa. Missile and Space Div.

THE LINEAR-GRAPH TECHNIQUE FOR FINDING POLYNOMIAL ROOTS

C. R. Seliger Jun. 1967 53 p refs Revised

(Doc-67SD269A)

The first four degrees of polynomial equations can be solved by formula. For higher-order equations, a special technique combining simple graphing and numerical methods is suggested, by which at least one real root will be obtained if, indeed, at least one real root exists. This technique for solving any order polynomial equation is fast, accurate, and reliable if the technique is applied as described in the article. This method will find only real roots; it will not locate roots of equations (higher than 5th degree) that possess solely complex roots. The primary advantage of this particular graphical technique is that it avoids the situation of "missing" a root located between two consecutive integers. Author

N68-22696# Los Alamos Scientific Lab., N. Mex.

VISUAL HULL OF A POLYHEDRON

W. A. Beyer [1967] 9 p refs Presented at Conf. on Projections and Related Topics, Clemson, S. C.

(Contract W-7405-ENG-36)

(LA-DC-9167; CONF-670833-1) CFSTI: HC$3.00/MF$0.65

The visual hull of a set in Euclidean 3-space is the largest set having the same orthogonal projections on all planes as the given set. It is shown how to construct a bounded polyhedron whose visual hull is not a polyhedron. Author (NSA)

N68-22805*# Brown Univ., Providence, R. I.

FINITE STATE STOCHASTIC GAMES. EXISTENCE THEOREMS AND COMPUTATIONAL PROCEDURES

Harold J. Kushner and Stanley G. Chamberlain [1967] 22 p refs

(Grants NGR-40-002-015; AF-AFOSR-693-67; NSF GK-967)

(NASA-CR-94428) CFSTI: HC$3.00/MF$0.65 CSCL 12A

Let $\{X_n\}$ be a Markov process with finite state space and transition probabilities $p_{ij}(u_i, v_i)$ depending on u_i and v_i. State 0 is the capture state (where the game ends: $p_{oi} = \delta_{oi}$), $u = \{u_i\}$ and $v = \{v_i\}$ are the pursuer and evader strategies, resp., and are to be chosen so that capture is advanced or delayed and the cost is minimaxed (or maximined). The existence of a saddle point and optimal strategy pair or ϵ-optimal strategy pair are considered. Recursive schemes for computing the optimal or ϵ-optimal pairs are given. The lattice and complete lattice structure for a set of vectors are given under the relevant partial orderings. Author

N68-22809*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GENERAL LAGRANGIAN INTERPOLATION FORMULAS

C. E. Velez Washington May 1968 17 p refs

(NASA-TN-D-4424) CFSTI: HC$3.00/MF$0.65 CSCL 12A

The development of high-degree interpolation polynomials which use the values of the function and its subsequent derivatives is discussed. It is shown that if data of this type are available, high-accuracy interpolation is possible under the restrictive conditions of large step-sizes and few data values. Author

N68-22948 California Univ., Berkeley.

SOME APPLICATIONS OF MODEL THEORY IN SET THEORY

Jack Howard Silver (Ph.D. Thesis) 1966 117 p

Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-5172

Known results concerning measurable cardinals, Erdos cardinals, and weakly compact cardinals are presented. Each real valued measurable is shown to have the tree property, and a number of results in model theory and the metamathematics of set theory are included. Dissert. Abstr.

N68-23030 Lockheed Missiles and Space Co., Palo Alto, Calif.

SOME CUBATURE FORMULAS FOR THE EVALUATION OF DOUBLE INTEGRALS

N. Ia. Liashchenko and Iu. S. Ramskii [1967] 10 p ref Transl. into ENGLISH from Vychisl. i Prikl. Matem. (Kiev), no. 3, 1967 p 46–57

Cubature formulas were constructed for an evaluation of double integrals, with the coefficients and nodes determined to have an algebraic degree of accuracy of 2r + 1. It was assumed that the nodes do not emerge beyond the limits of the specified rectangle and that the integrand has continuous partial derivatives up to the order 2r + 2 in the domain of integration. Attention is given to formulas with certain accuracy levels, and the obtained cubature formulas are used to compute some integral values and determine their absolute errors. It is noted that the function used in these determinations does not satisfy the additional conditions imposed on the integrand during the derivations for any of the cubature formulas. M.W.R.

N68-23037# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BOUNDARY-VALUE PROBLEMS FOR SECOND-ORDER DIFFERENTIAL EQUATIONS IN A BANACH SPACE [GRANICHNYYE ZADACHI DLYA DIFFERENTSIAL'NYKH URAVNENIY VTOROGO PORYADKA V BANAKHOVOM PROSTRANSTVE]
S. G. Kreyn and G. I. Laptev 29 Aug. 1967 21 p refs Transl. into ENGLISH from Differentsial'nyye Uravneniya (USSR), v. 2, no. 3, 1966 p 382–390
(FTD-HT-67-128; AD-666738)

It is indicated that a series of problems in mathematical physics (theory of wave-guides, hydrodynamics, and others) can be considered as boundary-value problems for the second-order equation the second derivative of u with respect to t = Au-f(t), 0 = or < t = or < T, where u(t) is a function to be determined and f(t) is a given function of a complex Banach space E and A in a bounded linear operator. The solution u(t) is sought which satisfies a system of boundary conditions. TAB

N68-23040# Wisconsin Univ., Madison. Mathematics Research Center.
UNIFORM APPROXIMATION BY TCHEBYCHEFFIAN SPLINE FUNCTIONS 2: FREE KNOTS
Larry Schumaker Oct. 1967 18 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-810; AD-666611)

Existence, uniqueness and characterization of best uniform approximations of continuous functions by (Tchebycheffian) spline functions with free knots in (a,b) are investigated. Author (TAB)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N68-21966# Miami Univ., Fla. Radar Meteorological Lab.
TROPICAL METEOROLOGY
Homer W. Hiser and Harold P. Gerrish Jan. 1968 242 p refs Proc. of 1967 Army Conf. on Trop. Meteorol., Coral Gables, Fla., 8–9 Jun. 1967
(Contract DAAB07-67-C-0224)
(ML-68063; Rept.-15; ECOM-C-224-15; AD-666229)

The primary interest of the meeting was in the realm of local, small-scale meteorological phenomena and problems in the tropics, specifically excluding hurricanes and typhoons, although the papers were not completely limited to those topics. The objective was to learn as much as possible about the recent results and future research plans of the U.S. Army Contractors in tropical meteorology and to benefit by the experience and special knowledge of other invited guests from the United States and abroad. Twenty papers were presented at the two-day meeting. Discussions of the papers were recorded and are included in the report. Author (TAB)

N68-22259 New York Univ., N. Y.
A PHYSICAL-NUMERICAL MODEL FOR THE PREDICTION OF SYNOPTIC SCALE LOW CLOUDINESS
Joseph Patrick Gerrity, Jr. (Ph.D. Thesis) 1966 133 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-6018

A system of equations governing the physical behavior of the atmosphere within the first two kilometers above the ground was formulated for solution on a high-speed digital computer. This physical-numerical model of the atmosphere was designed to permit the investigation of the significance of certain atmospheric boundary layer processes for the development of horizontally extensive areas of low cloudiness. Numerical solutions of the model equations were computed for three synoptic cases. The initial state of the atmosphere was analyzed from synoptic surface and upper-air observations in the eastern United States. The numerical solutions were extended to cover a forecast period of twelve hours in each case. The predictions were made on a finite-difference mesh with twelve hundred grid points. The vertical coordinate was defined by twelve grid points over each of one hundred grid points in the horizontal plane. Dissert. Abstr.

N68-22267 Florida State Univ., Tallahassee.
A LABORATORY HURRICANE MODEL INCORPORATING AN ANALOG TO RELEASE OF LATENT HEAT
Ronald K. Hadlock (Ph.D. Thesis) 1966 145 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-6467

An entirely new technique, taking the form of a chemical analog to the atmospheric process of latent heat release upon condensation of water vapor, is employed in a liquid model of the hurricane circulation. Hadley-regime flow is established in an environment of acid solution through cooling at the upper periphery in the presence of suitable rotation. Chemical base solution is introduced in the resulting low-level inflow layer. Mixing of the two solutions occurs to release neutralization heat and to form neutralization products. Both effects result in buoyancy of the neutral solution. Organization of flow develops with the establishment of central structure which displays similarity to a prototype hurricane in several ways. The prototype is defined as an axially-symmetric, well-developed, steady-state idealization of a real hurricane. Outstanding among the similarities is the development of a rotating, ring-shaped, convective wall structure with descent interior to the wall. Dissert. Abstr.

N68-22481# Joint Publications Research Center, Washington, D. C.
METEOROLOGY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 179 6 May 1968 p 9–39 refs (See N68-22479 12-13)

News articles and scientific activities by Soviet bloc nations in the field of meteorology are summarized, including information on weather satellites, meteorological rockets and balloons, and various atmospheric findings. News stories deal with measuring and reducing meteorological parameters, radar set and radar echo applications, and various types of instruments. The 35 abstracts presented cover weather forecasting, wind profiles and other climatological aspects, and atmospheric models and measuring instruments. Much of the data deals with climatology in various parts of the Soviet Union. M.W.R.

N68-22576 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 79, NO. 11: DAILY AND AVERAGE SURFACE MAPS AND 850 MB MAPS OF THE NORTHERN HEMISPHERE DURING 1967 [METEOROLOGISCHE ABHANDLUNGEN. BAND 79, HEFT 11: TAEGLICHE UND MITTLERE BODEN- UND 850-MB-KARTEN DER NORDHEMISPHAERE IM JAHRE 1967]
Manfred Geb, Richard Scherhag, et al Nov. 1967 80 p refs In GERMAN

A summary of the world weather situation is presented for November 1967 in addition to daily 850-mb and ground level charts of the Northern Hemisphere for the same month. Transl. by K.W.

N68-22874 Freie Univ., Berlin (West Germany). Institut fuer Meteorologie und Geophysik.

METEOROLOGICAL DATA. VOLUME 76, NO. 11: RESULTS OF THE ASCENTS OF THE RADIOSONDESTATION BERLIN–TEMPELHOF OF THE INSTITUT FUER METEOROLOGIE UND GEOPHYSIK OF THE FREIE UNIVERSITAET BERLIN, NOVEMBER 1967 [METEOROLOGISCHE ABHANDLUNGEN. BAND 76, HEFT 11: ERGEBNISSE DER AUFSTIEGE DER RADIOSONDENSTATION BERLIN–TEMPELHOF DES INSTITUTS FUER METEOROLOGIE UND GEOPHYSIK DER FREIEN UNIVERSITAET BERLIN IM JAHRE 1967, NOVEMBER]

Richard Scherhag et al 1968 110 p In GERMAN; ENGLISH summary

CFSTI: $3.00

The detailed results of the daily radiosonde ascents during November 1967, performed by the aerological station of the institute, are presented. Extreme and mean values of the temperature, geopotential, pressure, wind data, refractivity, density, pseudopotential temperature, and velocity of sound for all standard pressure surfaces and for several height levels, the tropopause, and the freezing level were extracted. Author

N68-22875 Freie Univ., Berlin (West Germany). Institut fuer Meteorologie und Geophysik.

METEOROLOGICAL DATA. VOLUME 76, NO. 10: RESULTS OF THE ASCENTS OF THE RADIOSONDESTATION BERLIN–TEMPELHOF OF THE INSTITUT FUER METEOROLOGIE UND GEOPHYSIK OF THE FREIE UNIVERSITAET BERLIN, OCTOBER 1967 [METEOROLOGISCHE ABHANDLUNGEN. BAND 76, HEFT 10: ERGEBNISSE DER AUFSTIEGE DER RADIOSONDENSTATION BERLIN–TEMPELHOF DER INSTITUTS FUER METEOROLOGIE UND GEOPHYSIK DER FREIEN UNIVERSITATE BERLIN IM JAHRE 1967, OKTOBER]

Richard Scherhag et al 1968 97 p In GERMAN; ENGLISH summary

CFSTI: $3.00

The detailed results of the daily radiosonde ascents during October 1967, performed by the aerological station of the institute, are presented. Extreme and mean values of the temperature, geopotential, pressure, wind data, refractivity, density, pseudopotential temperature, and velocity of sound for all standard pressure surfaces and for several height levels, the tropopause, and the freezing level were extracted. Author

N68-22969# Freie Univ., Berlin (West Germany). Institut fuer Meteorologie und Geophysik.

METEOROLOGICAL DATA. VOLUME 74, NO. 1: HIGHEST AND LOWEST VALUES OF ATMOSPHERIC PRESSURE AT GROUND-LEVEL, NORTH ATLANTIC REGION, 1931–1965 [METEOROLOGISCHE ABHANDLUNGEN. BAND 74, HEFT NO. 1: HOECHSTE UND TEIFSTE WERTE DES BODENLUFTDRUCKES IM NORDATLANTISCHEN RAUME, 1931 BIS 1965]

Harald Wieder 1967 56 p refs In GERMAN; ENGLISH summary

CFSTI: HC$3.00/MF$0.65

An attempt is made to find out the highest and lowest values of atmospheric pressure at sea-level for the extended normal period 1931 to 1965 and to show their annual variations. Tropical cyclones were not considered, their tracks though were showed on special maps. The extremes were defined by means of tables and daily weather maps within a network of selected points and entered into maps. Points of the same extreme atmospheric pressure were connected. The date given marks the time of the strongest intensity of cyclones or anti-cyclones. Author

N68-22977# Freie Univ., Berlin (West Germany). Institut fuer Meteorologie und Geophysik.

METEOROLOGICAL DATA. VOLUME 62, NO. 3: AEROLOGY REPORTS ON THE STRATOSPHERE OVER BERLIN, 1966 [METEOROLOGISCHE ABHANDLUNGEN. BAND 62, NO. 3: BEITRAEGE ZUR AEROLOGIE DER STRATOSPHAERE UEBER BERLIN IM JAHRE 1966, TEIL 3] Quarterly Report, Jul.–Sep. 1966

Edgar Maedlow and Eugen Pantzke 1967 47 p refs In GERMAN; ENGLISH summary Supported in part by Ger. Res. Organ.

(QR-3) CFSTI: $3.00

Using the daily measurements of the radiosonde station of the Free University of Berlin time cross sections of temperature and the zonal and meridional wind components in heights above 30 km for July, August and September 1966 were constructed. Weather conditions at the 10-mb-region are discussed, and climatological data for the summer of 1966 are given. Author

N68-22978# Forsvarets Forskningsanstalt, Stockholm (Sweden).

THE DYNAMICS OF THE EXPLOSION CLOUD. 1: A THEORETICAL MODEL FOR NUMERICAL CALCULATION OF THE THERMODYNAMIC PROCESSES DURING THE CLOUD DEVELOPMENT

B. Rydgren Jan. 1968 35 p refs

(FOA-4-4329-28)

Studies on the physical-meteorological factors, which affect the development of the explosion cloud are discussed. The main purpose was to describe the thermodynamic processes, starting from a point corresponding to a mean cloud temperature of about 1000° to 1500°K. Factors were studied, which influence the cloud temperature—radiation, adiabatic cooling, and entrainment from the ambient air. Concerning the adiabatic changes of temperature above the condensation level, a special model was applied which permits the calculation of the total water content of the cloud. The distribution of the vertical velocity was also obtained, from the temperature functions. It gave a rough time scale for the different phases of the cloud development. The results were derived for constant height intervals by numerical data processing applied to the basic differential equations. The numerical calculations were performed on an IBM 7090 computer. The program permits a great variation of the initial and the meteorological data. Author (NSA)

N68-23018 Freie Univ., Berlin (West Germany). Institut fuer Meteorologie und Geophysik.

METEOROLOGICAL DATA. VOLUME 66, NO. 4: DAILY ALTITUDE MAPS OF THE 50 MB LEVEL ACCORDING TO MONTHLY MEAN MAPS [METEOROLOGISCHE ABHANDLUNGEN. BAND 66, HEFT 4: TAEGLICHE HOEHENKARTEN DER 50-MB-FLAECHE SOWIE MONATLICHE MITTELKARTEN FUER DAS JAHR 1966. TEIL 4, 4. VIERTELJAHR] Quarterly Report, 1966

Regina Kirch, Barbara Kriester, Karin Labitzke, Richard Scherhag, and Renate Stuhrmann 1967 113 p

In addition to the daily 50-mb charts of the Northern Hemisphere for the last quarter of 1966, this volume contains: (1) charts of the monthly means, deviations, and changes for the same level; and (2) an analysis of the stratospheric circulation for the 50-mb level. Transl. by K.W.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N68-21987# Royal Aircraft Establishment, Farnborough (England).
A SIMULATOR INVESTIGATION OF THE PROBLEM OF VISUAL TAXI-GUIDANCE IN LOW VISIBILITIES
A. D. Brown, N. J. Jeffs, and Leslie Betts Aug. 1967 51 p refs
(RAE-TR-67170) CFSTI: HC$3.00/MF$0.65

Two experiments performed using the B.L.E.U. approach, landing and take-off simulator are described. These were designed to provide quantitative information on the problems of visual taxi-guidance in low visibilities. A typical modern airliner was simulated and the taxiway comprised of 6600 ft line of white lights, with eight bends of differing radii arranged along its length. The effect of the pilots' performance of visual range, light-spacing, speed, bend curvature and the use of a ground speed indicator were investigated. The results show that taxying in runway visual ranges down to 50 m using only visual guidance is feasible and such a system has a number of advantages. Suggestions are made for improving the effectiveness of visual guidance. A recommendation is made for a further series of taxi experiments and the possible points for future study are briefly outlined. Author (ESRO)

N68-22036# Manufacture Belge de Lampes et de Materiel Electronique, Brussels (Belgium).
ELDO GUIDANCE STATION [LA STATION DE GUIDAGE ELDO]
H. Vigneron 1966 10 p In FRENCH *Its* MBLE Rev., Vol. 9, No. 1
CFSTI: HC$3.00/MF$0.65

Belgium has the task to perform the guidance and the injection into orbit of the satellite within the framework of the European spacecraft launch program. The launching base is located at Woomera (South Australia). Belgium will set up a radioelectric guidance station at Gove (Northern Australia). Measurements of the spacecraft parameters will be performed by means of an interferometric system fed by five antennas: an electronic computer will calculate the orders to be transmitted by means of a sixth antenna to the spaceborne responder. In the case of a circular orbit the eccentricity tolerated must be smaller than 2×10^{-3}. Author (ESRO)

N68-22175 Florida Univ., Gainesville.
OPTIMIZATION THEORY FOR MULTIVARIATE REGRESSION ANALYSIS OF SATELLITE AND SPACE NAVIGATION SYSTEMS
Myron Anton Bondelid (Ph.D. Thesis) 1966 129 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-3460

This dissertation presents theorems and results related to several analytic methods, plus the results from an empirical method, to optimize the biased estimation of a set of parameters from observations of noisy signals. The basic mathematical structure, within which it has been found convenient to study multivariate regression analysis problems is presented first, resulting in the definition for the fundamental space called a Quadratic Finite Dimensional pre-Hilbert space. Two regression analysis techniques are presented, the first of which is also called a weighted least squares estimation and the second, sequential estimation. All four analytic methods and the empirical method, called ϕ-Plane Navigation, are tested computationally against the same problem; ship navigation involving four parameters, two in position and two in velocity. Representative results show that three of the methods produce improved estimates for the four parameters.
Dissert. Abstr.

N68-22216 Lehigh Univ., Bethlehem, Pa.
COMPARATIVE ANALYSIS OF VARIOUS METHODS OF PREDICTION OF THE RESPONSE OF UNGUIDED ROCKETS TO RANDOM STATIONARY WIND FIELDS
Chetan Lalchand Karna 1966 118 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-4870

The problem considered in this dissertation is that of the prediction of the angle at burnout of an unguided rocket from wind-velocity measurements taken at various levels prior to firing. The first method discussed is based on the optimum linear mean-square estimation of the rocket response from wind-velocity measurements at all levels. Since this method in general involves untractable computations, two alternate approaches are considered. One consists in determining the response of the rocket at various times prior to firing, and extrapolating to firing time the response record thus obtained. The other consists in extrapolating to firing time the wind velocity at each level, neglecting any interlevel cross-correlation, and computing the response of the rocket to the extrapolated wind profile thus obtained. The mean-square errors associated with the proposed methods are compared under various conditions. Particular attention is given to the case when the wind-velocity may be represented at each level by a stationary Markov process. Dissert. Abstr.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N68-21856# Technische Hochschule Stuttgart (West Germany). Institut fuer Kernenergetik.
RESULTS OF STUDIES ON THERMIONIC REACTOR SYSTEMS [ERGEBNISSE VON STUDIEN UEBER THERMIONIKREAKTOR SYSTEME]
R. Pruschek, S. Dagbjartsson, D. Emendoerfer, M. Groll, W. Haug et al [1968] 39 p refs In GERMAN; ENGLISH summary Presented at DGLR Symp. on Energy Provision in Space No. 2, Munich, 14 Mar. 1968
(Rept.-68-007) CFSTI: HC$3.00/MF$0.65

The following systems were studied: (1) thermal in-core thermionic reactors; (2) thermal double diode thermionic reactors; (3) fast in-core thermionic reactors; (4) fast heat pipe thermionic reactors; and (5) fast thermionic reactors with emitter heated by heat radiation. Such characteristics data as fissionable material requirements, power output, specific power, mass of components, and total mass are given. Problems of power flattening, long-time behavior, converter–nuclear heat source integration, and specific design features are discussed. K.W.

N68-21891 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
ULTRASONIC BAND TESTING BETWEEN TUBES AND METALLIC URANIUM CORE IN NUCLEAR FUEL ELEMENTS [ULTRADZWIEKOWE BADANIA PRZYLEGANIA KOSZULKI DO RDZENIA Z METALICZNEGO URANU]
Z. Pawloski and M. Wiaderny 1967 26 p In POLISH; ENGLISH summary
(Rept.-856/14/PS) CFSTI: $3.00

The ultrasonic immersion testing of nuclear fuel elements is described. The examination was carried out on experimental nuclear fuel elements manufactured according to the technology elaborated in Nuclear Research Institute. It is shown that the ultrasonic method of testing makes it possible to detect not only the unbonding between tube and metallic uranium core. The traces on the oscilloscope screen give also information on the internal defects, the density and porosity of metallic uranium core. The conclusion on these two latter inhomogeneities could be drawn from

ultrasonic velocity and attenuation measurements. The principles for the interpretation of oscilloscope traces as well as characteristic oscilloscope traces connected with different defects are given.
Author

N68-21924*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

APPLICATIONS OF MONTE CARLO ANALYSIS TO TUNGSTEN RESONANCE ABSORPTION

Robert M. Westfall Washington May 1968 47 p refs
(NASA-TN-D-4545) CFSTI: $3.00 CSCL 18F

Calculational procedures for Monte Carlo analyses and tungsten resonance absorption are presented. The widely used flat spatial neutron source assumption is shown to overestimate the effective resonance integral of the large scattering resonance in W^{186} by 21 percent at a surface to mass ratio (S/M) of 0.5 cm^2/g. Resonance overlap in natural W decreases the effective resonance integral by 18 to 7 percent over a S/M range of 0.16 to 4.0 cm^2/g relative to calculations which ignore resonance overlap. Spatial self-shielding in a complex geometric cell is evaluated through comparison of Monte Carlo calculations with exact geometric and homogenized absorber region representations. The code EPIGRAM, which selects energy points for resonance cross sections, is reported.
Author

N68-21968*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MATERIAL REQUIREMENTS FOR DYNAMIC NUCLEAR SPACE POWER SYSTEMS

Thomas A. Moss, Robert L. Davies, and Paul E. Moorhead Washington 1967 67 p refs Presented at Inter Ann. Meeting of the ASME, Pittsburgh, 12–17 Nov. 1967
(NASA-TM-X-52344) CFSTI: HC$3.00/MF$0.65 CSCL 18J

As the sophistication of space missions increases, the demand for electrical power and the mission duration will increase. For missions with durations longer than 10 weeks that require power at levels above 2 kWe, the dynamic radioisotope and the nuclear reactor systems offer significant advantages over photocell and fuel cell systems. This paper compares a 6 kWe isotope Brayton and a 300 kWe Ranking Cycle system. The high operating stresses and temperatures, the environment and the long operating life require a thorough evaluation of materials to establish long time creep, compatibility, welding and thermal aging properties. An adequate materials program prior to the system development will contribute to better system performance and a shorter development program.
Author

N68-21972 Joint Publications Research Service, Washington, D. C.

STUDIES IN FUEL ELEMENTS AND RADIOACTIVE ISOTOPES

18 Apr. 1968 19 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow) v. 2, issue 2, Feb. 1968 p 136–143, 203–204
(JPRS-45100) CFSTI: $3.00

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1. STUDY OF FUEL ELEMENT PACKAGE OF BR-5 REACTOR WITH PLUTONIUM DIOXIDE FUEL O. D. Kazachkovskiy, S. N. Votinov, I. G. Lebedev, V. I. Kuz'min, V. N. Syuzev et al p 1–14 refs (See N68-21973 12-22)

2. ISOTOPIC ELECTRIC POWER SOURCES FOR RADIOMETEOROLOGICAL STATIONS G. M. Fradkin, V. M. Kodykov, A. I. Ragozinskiy, Ye. A. Kazakov, N. P. Korotkov et al p 15–19 refs (See N68-21974 12-22)

N68-21973 Joint Publications Research Service, Washington, D. C.

STUDY OF FUEL ELEMENT PACKAGE OF BR-5 REACTOR WITH PLUTONIUM DIOXIDE FUEL

O. D. Kazachkovskiy, S. N. Votinov, I. G. Lebedev, V. I. Kuz'min, V. N. Syuzev et al *In its* Studies in Fuel Elem. and Radioact. Isotopes 18 Apr. 1968 p 1–14 refs (See N68-21972 12-22)

A working package of a BR-5 reactor with a PuO_2 fuel attaining a 6.1% burnup was investigated that had been at the reactor core for 5-1/2 years. Fuel elements of the package, with a steel alloy jacket, were found to be in satisfactory condition after burnup with the exception of the central element which had two longitudinal cracks on opposite sides of its entire length. Gaseous fission fragments under the jacket constituted about 80% of those formed, there was gas swelling of PuO_2 at temperatures between 900 and 1,400°C, and the working reserve of the fuel elements was virtually exhausted. The PuO_2 became amorphous when irradiated at a reduced temperature, although its structure was restored following sintering at 1,000°C; although the plutonium dioxide lattice period remained constant. Strong hardening and decrease in plasticity of the worked material of the jacket apparently occurred from long term effects of low stresses from heat carrier pressure on the material.
M.W.R.

N68-21974 Joint Publications Research Service, Washington, D. C.

ISOTOPIE ELECTRIC POWER SOURCES FOR RADIOMETEOROLOGICAL STATIONS

G. M. Fradkin, V. M. Kodykov, A. I. Ragozinskiy, Ye. A. Kazakov, N. P. Korotkov et al *In its* Studies in Fuel Elem. and Radioact. Isotopes 18 Apr. 1968 p 15–19 refs (See N68-21972 12-22)

Thermoelectric means are being used to convert the thermal energy released during decay of radioactive isotopes into electrical energy as a source of electric power for radio meteorological stations in the Soviet Union. An experimental isotopic generator called Beta 1 is described that uses cesium 144 and has a power of 5 W; and various modifications to this generator are also considered.
M.W.R.

N68-21999 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

TEST LAYERS DESIGNED TO MAKE MACROSCOPIC OBSERVATIONS OF RADIOACTIVE SAMPLES FOR THE HEAT CHAMBER OF THE EWA REACTOR PILE [STANOWISKO DO BADAN MAKROSKOPOWYCH PREPARATOW RADIOAKTWNYCH W KOMORZE GORACEJ REAKTORA EWA]

B. Bochenek, W. Kasprzykowski (Central Opt. Lab., Warsaw), S. Pracki (Central Opt. Lab., Warsaw), and A. Stanek 1967 44 p refs In POLISH
(IBJ-870/14/PS) CFSTI: $3.00

Arrangement and operation of the equipment for the remote macroscopic observation of radioactive samples in the chamber of the EWA reactor are described. The apparatus consists of a monocular periscope coupled to a remote control manipulator unit which permits movement in three directions. Visual enlargements of 5, 7.5, and 15 times are possible with the periscope. A camera is also provided for recording photographic enlargements.
Transl. by K.W.

N68-22022*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

GAMMA FLUX AND HEAT DEPOSITION IN PLUM BROOK REACTOR—COMPARISON OF CALCULATION AND EXPERIMENT

Robert J. Bacigalupi and Byron E. Thinger Washington Apr. 1968 24 p refs
(NASA-TM-X-1539) CFSTI: HC$3.00/MF$0.65 CSCL 18M

A computerized point-kernel technique (QAD-P5) was used to calculate a gamma-heating map of a thermionic diode experiment proposed to be irradiated in the Plume Brook reactor core. A replica of the diode was used in the low-power mockup reactor at

Plum Brook to generate corresponding gamma-heating maps experimentally using lithium fluoride dosimetry. A detailed comparison of experimental and calculated values generally showed agreement to within ±25 percent. Proper interpretation of the measured values is discussed herein. Author

N68-22038*# United Aircraft Corp., East Hartford, Conn.
STUDIES OF SPECIFIC NUCLEAR LIGHT BULB AND OPEN-CYCLE VORTEX STABILIZED GASEOUS NUCLEAR ROCKET ENGINES
G. H. Mc Lafferty and H. E. Bauer Washington NASA Apr. 1968 102 p refs
(Contract NASw-847)
(NASA-CR-1030; F-910093-37) CFSTI: HC $3.00/MF $0.65 CSCL 21F

Analytical studies were conducted to determine the characteristics of two specific vortex-stabilized gaseous nuclear rocket engines: a nuclear light bulb engine and an open-cycle engine. Both engines are based on the transfer of energy by thermal radiation from gaseous nuclear fuel suspended in a vortex to seeded hydrogen propellant. The two engines differ in that the nuclear light bulb engine employs an internally-cooled transparent wall to separate the fuel-containing vortex region from the propellant region, while the open-cycle engine relies entirely on fluid mechanics containment for preferential retention of the nuclear fuel. The majority of the work has been directed toward the nuclear light bulb engine, since recent fluid mechanics results indicate that the fuel retention characteristics of an open-cycle vortex-stabilized engine are insufficient to provide economic fuel containment. The nuclear light bulb engine offers the possibility of providing essentially perfect containment of the nuclear fuel. The studies indicate approximate values of the thrust, weight, and specific impulse of both configurations. Author

N68-22088*# United Aircraft Corp., East Hartford, Conn.
EXPERIMENTAL INVESTIGATION OF RADIAL-INFLOW VORTEXES IN JET-INJECTION AND ROTATING PERIPHERAL-WALL WATER VORTEX TUBES
Arthur Travers Washington NASA Apr. 1968 38 p refs
(Contract NASw-847)
(NASA-CR-1028; F-910091-14) CFSTI: HC $3.00/MF $0.65 CSCL 21F

Experiments were conducted in water vortex tubes to determine the effects of peripheral-wall injection area and axial bypass on the flow pattern and location of the radial stagnation surface in radial-inflow vortexes. The particular type of flow pattern investigated contains a central cell region which is bounded on the outside by a radial stagnation surface which appears to be laminar. At the radius of the radial stagnation surface, all radial flow passes through the end wall boundary layers. The flow in the vortex is laminar for radii less than that of the radial stagnation surface and is turbulent at larger radii. Tests were conducted with different combinations of tangential injection and radial Reynolds numbers, different amounts of bypass flow, and different peripheral-wall injection areas. The characteristics of the flow and the radius of the radial stagnation surface were determined from observations and photographs of dye patterns. The results of the experiments were compared with the results of a previous theoretical investigation of confined vortex flows. Author

N68-22327# Idaho Nuclear Corp., Idaho Falls.
THE DEVELOPMENT OF POWDERED URANIUM-ALUMINIDE COMPOUNDS FOR USE AS NUCLEAR REACTOR FUELS
G. W. Gibson Dec. 1967 82 p refs
(Contract AT(10-1)-1230)
(IN-1133) CFSTI: HC $3.00/MF $0.65

The use of uranium-aluminide powders in dispersion-type, aluminum-clad fuel elements was investigated. Fuel plates, made by powder metallurgical techniques using these powders, have been fabricated and tested under a variety of conditions. These tests have shown this approach to be satisfactory and advantageous for use in the preparation of fuel elements for high-flux, high-power-density nuclear reactors. Author (NSA)

N68-22328# Bettis Atomic Power Lab., Pittsburgh, Pa.
ADDITIONAL STUDY OF MODELS FOR RADIATION DAMAGE EXPOSURE
K. Shure Nov. 1967 12 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-471, Add. 1) CFSTI: HC $3.00/MF $0.65

Available data on the change in transition temperature for A302B pressure vessel steel have been correlated with irradiation exposure based on a step function damage model for several threshold energies. Correlations using a 0.4-0.5 MeV threshold energy predict transition temperature changes comparable to those previously obtained using an energy dependent damage model. Author (NSA)

N68-22329# Bettis Atomic Power Lab., Pittsburgh, Pa.
DIRECT MEASUREMENT OF THE SHUTDOWN REACTOR ASYMPTOTIC EIGENVALUE
J. F. Walter Jun. 1967 13 p refs Presented at 13th Ann. Meeting of the Am. Nucl. Soc., San Diego, Calif., Jun. 1967
(Contract AT(11-1)-GEN-14)
(WAPD-T-1955) CFSTI: HC $3.00/MF $0.65

The asymmetry source experiment for measuring the asymptotic eigenvalue of a shutdown reactor or critical assembly is described. Calculations are given. Possible use as a reactivity meter is hypothesized. NSA

N68-22411# Oak Ridge National Lab., Tenn.
BEHAVIOR OF OXIDE AEROSOLS OF URANIUM AND STAINLESS STEEL IN HUMID ATMOSPHERE
W. D. Yuille and R. E. Adams Jan. 1968 43 p refs
(Contract W-7405-ENG-26)
(ORNL-4198) CFSTI: HC $3.00/MF $0.65

Laboratory experiments were made to examine the effect of moisture on aerosols produced by arc-melting simulant reactor fuel in air. The only simulant used was stainless steel clad UO_2. An effect of moisture was obtained by either generating the aerosol in 80 to 90% relative humidity air or by bubbling the dry generated aerosol through water. Analysis of samples taken with thermal precipitators and by fibrous filter analyzers showed that the presence of moisture does affect both size and shape of aerosol agglomerates. A marked reduction in filtering efficiency of the wet aerosol was measured through open structure roughing filters. Humidity does not bring about physical changes by operating on the electrical charge properties of the aerosol. A chemical reaction between water vapor and the constituents of the aerosol agglomerates initiates the changes in particle size and shape observed. Author (NSA)

N68-22446# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
SPECTRUM INDICES MEASUREMENTS IN ORGEL TYPE UC CLUSTER FUEL ELEMENTS
F. Conti 1968 40 p refs
(EUR-3736.e)

Results of index spectrum measurements performed in natural UC cluster type fuel elements are described. Both the epithermal and the thermal spectrum indices were determined by means of integral activation techniques, using foil detectors with resonances, respectively in the epithermal and maxwellian regions. The resonance activities are normalized to that of a 1/V detector. The activity ratios are interpreted with the aid of the Westcott's convention. Author (NSA)

N68-22452# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

COMPARISON OF SOME MEASURED AND CALCULATED REACTION RATES IN HIFAR

A. Bicevskis, D. Culley, E. Hesse, and T. Wall Sep. 1967 29 p refs

(AAEC/TM-408)

The neutron spectrum and flux distribution in the reactor HIFAR was studied by using several fuel cell models and comparing calculated and measured reaction rates and neutron spectra. Satisfactory agreement was obtained between theory and experiment when the complex geometry of the fuel element and the effects of neighboring elements were taken into account. Author (NSA)

N68-22453# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

NEUTRON TIME-OF-FLIGHT SPECTROMETRY FOR A CHOPPER WITH VANES LEAKAGE

F. A. Rocke Oct. 1967 46 p refs

(AAEC/E-186)

A theory of neutron spectrometry for a chopper is presented which includes neutron leakage through the rotating slit vanes. Experimental checks of the theory are presented which involve differential spectrum measurements with a chopper on graphite-moderated neutrons from the reactor MOATA. Theory and experiment are in good agreement. Author (NSA)

N68-22455# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

THE FABRICATION OF U233/ALUMINUM FUEL PLATES FOR A SUBCRITICAL ASSEMBLY

J. Bardsley and A. Ridal Aug. 1967 20 p refs

(AAEC/TM-404; Rept.-2)

Uranium-233 (as 938.66 g UO_2) was fabricated into 176 full-size, 20 half-size and 2 quarter-size Al clad fuel plates. Each full-size plate contained 5 compacts and half-size and quarter-size plates contained 2 compacts and 1 compact respectively; a compact consisted of a cold-pressed dispersion of about 1.5 g of UO_2 in Al. The technique involved mixing UO_2 and Al powders, pressing the compacts in a steel die, end-loading them into a prefabricated Al can and end-welding the can; following this the can underwent radiographic inspection for uniformity, decontamination, leak detection and acceptance tests, and final decontamination. Maximum permissible radiation doses to hands and bodies of the operators were not exceeded. Author (NSA)

N68-22456# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

SURVEY OF THE STORAGE BEHAVIOUR OF URANIUM DIOXIDE

M. J. Bannister Jul. 1967 21 p refs

(AAEC/TM-396)

The storage behavior of uranium dioxide powder is reviewed. Topics covered include the amount of oxygen taken up under storage conditions, the basic oxidation processes, the effects of extra oxygen on the fabrication and irradiation behavior of uranium dioxide, the pyrophoric reaction of uranium dioxide powders in air, the stabilization of uranium dioxide against oxidation, and the effectiveness of sealed containers. The pyrophoric process in air at room temperature is shown to be the result of rapid chemisorption of oxygen, and a theory explaining this effect is developed. Equations are also derived to describe the overall oxidation behavior in air at room temperature, and they are found to agree with what few experimental data are available. Author (NSA)

N68-22459# Argonne National Lab., Ill.

ANL-CANDID, A TWO-DIMENSIONAL, DIFFUSION-THEORY CODE BASED ON CANDID2D

G. K. Leaf, A. S. Kennedy, and G. C. Jensen Sep. 1967 202 p refs

(Contract W-31-109-ENG-38)

(ANL-7305) CFSTI: HC$3.00/MF$0.65

ANL-CANDID is an extension and modification of the two-dimensional diffusion-theory code CANDID2D developed by Computer Applications Incorporated (CAI) for use on the CDC 3600 computer. The code, as delivered, was capable of performing a reactivity calculation as well as geometry, composition, and buckling searches. These calculations were limited to rz geometry. In addition, the code could perform an up-scattering calculation. The present code is the result of extending and modifying the CAI code. The extensions include the capability of performing calculations in xy and $r\theta$ geometry, including the full periodic case. Adjoint and source calculations were added with an acceleration procedure for the source calculation. In addition, an α calculation was added. The use of two-term Chebyshev extrapolation was retained; however, the strategy for employing it was changed. In addition, the strategy employed in the search procedure was completely changed. Mesh refinement and restart capability have been provided. Author (NSA)

N68-22471# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

YIELDS OF TRANSCURIUM NUCLIDES IN THE SRP HIGH FLUX REACTOR

H. Perry Holcomb Dec. 1967 11 p refs

(Contract AT(07-2)-1)

(DP-1137) CFSTI: HC$3.00/MF$0.65

Yields of the transcurium nuclides (through mass 255) produced in four $^{242}PuO_2$ targets that were irradiated in the Savannah River Plant high-flux reactor were measured by chemical analysis and radio-assay. Total integrated exposure of individual targets ranged from 3.8×10^{22} to 9.3×10^{22} n/cm^2. Author (NSA)

N68-22472# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.

A DYNAMIC PROGRAMMING ALGORITHM OF THE UNITED STATES URANIUM-235 PRODUCTION FACILITIES

W. L. Kephart, J. R. Copper, and T. E. Pritchard 13 Feb. 1968 72 p refs

(Contract W-7405-ENG-26)

(K-1712) CFSTI: HC$3.00/MF$0.65

A mathematical model of this production complex has been formulated to assist in conducting a more effective analysis of this economic system. Use of this particular model is not the only mode of analysis in this area of endeavor; however, it is one of the more comprehensive. Primarily, it is used to gain more insight into the encompassing environment and to provide a basis for further studies. The model is designed within the framework of dynamic programming and utilizes the backward algorithm with analytic stage solutions. The model simulates various economic situations and illustrates the diverse types of analyses produced. Special attention is given to the techniques used to minimize data handling, edit the input data, maintain a historical library of case results, and generate various types of reports. An automated technique devised to provide plots from data retained within the historical files is also reviewed. NSA

N68-22527# Argonne National Lab., Ill.

REACTOR DEVELOPMENT PROGRAM Progress Report

31 Jan. 1968 168 p refs

(Contract W-31-109-ENG-38)

(ANL-7403) CFSTI: HC$3.00/MF$0.65

Reported are studies on: (1) *Reactor Fuel Elements*—postirradiation measurements on metal alloys and trace impurities, fabrication of stainless steel jackets, and temperature and pressure effects on fuel elements; (2) *Liquid Metal Cooled Reac-*

tors—fuel developments; (3) *Fast Reactors*—fuel developments, calculations of neutron fluxes, and heat transfer model for reactor safety analysis; and (4) *Uranium Alloys*—radiation effects on Pu–U–Zr system. G.G.

N68-22536# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

PRELIMINARY RADIOLOGICAL CONSIDERATIONS INVOLVED WITH THE EXAMINATION OF IRRADIATED FFTF FUEL ELEMENTS

A. J. Stevens, F. Swanberg, and E. C. Watson Dec. 1967 16 p ref
(Contract AT(45-1)-1830)
(BNWL-566) CFSTI: HC$3.00/MF$0.65

The determination of appropriate criteria for contamination control in the Fast Flux Test Facility (FFTF) which will allow the processing and examination of the FFTF fuel for any period up to 50 days after discharge is described. Selected isotopes of the fission product inventories are used to establish a group β–γ activity estimate as a function of fuel exposure, and time since irradiation. Initially, it was assumed that the ratio of β–γ activity to α activity might be a useful index for controlling α contamination based on β–γ sensitive air monitoring of the FFTF fuel examination facilities. Results show that alpha sensitive air monitoring equipment will be necessary. Author (NSA)

N68-22537# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

REACTOR FUELS AND MATERIALS DEVELOPMENT PROGRAMS FOR FUELS AND MATERIALS BRANCH OF USAEC DIVISION OF A REACTOR DEVELOPMENT AND TECHNOLOGY Quarterly Progress Report, Apr.–Jun. 1967

F. W. Albaugh, S. H. Bush, J. J. Cadwell, D. R. de Halas, and D. C. Worlton Sep. 1967 198 p refs
(Contract AT(45-1)-1830)
(BNWL-473) CFSTI: HC$3.00/MF$0.65

Ten sections on reactor fuels and materials development programs are presented. A separate abstract was prepared for each section. NSA

N68-22538# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

REACTOR PHYSICS DEPARTMENT TECHNICAL ACTIVITIES Quarterly Report, Apr.–Jun. 1967

Jan. 1968 84 p refs
(Contract AT(45-1)-1830)
(BNWL-534) CFSTI: HC$3.00/MF$0.65

The following topics are discussed: (1) Computer programs for fast reactors; (2) reactivity and power distribution measurements, variable temperature effects, and reactor neutron multiplication factor for reactor fuel elements; (3) neutron flux and fuel element reactivity measurements for plutonium recycle test reactor; (4) reactivity measurements for boron batch core; (5) lattice parameters of uranium dioxide clusters and temperature coefficient calculations for uranium oxide–thorium oxide reactor fuels; (6) reactivity core measurements for plutonium recycle critical facility; (7) Doppler coefficient measurements for high temperature lattice test reactor; (8) physical characteristics and control analyses of fast test reactors; (9) fuel pin temperatures at reactor accident; (10) neutron fission rate and spectrum measurements for critical assemblies; (11) neutron fission rates for uranium isotope 239; (12) neutron fission rates for plutonium isotope 239; (13) reactivity calculations for reactor control elements; (14) critical uranium enrichment for uranyl nitrate; (15) excess reactivity of uranyl nitrate; (16) uranium enrichment for uranyl nitrate reactivity in physical constants test reactor; (17) high resolution monochromatization of neutrons; and (18) computer program for relativistic motion plotting of charged particles. G.G.

N68-22540# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

CALCULATION METHODS FOR MULTIGROUP NEUTRON CROSS SECTIONS USED IN BURNUP STUDIES

J. P. Pollard (M.S. Thesis—New S. Wales Univ.) Oct. 1967 49 p refs
(AAEC/E-184)

Calculation of burnup of material composing a nuclear reactor is important in a feasibility study of lifetime of fuel in possible reactor systems. Discussed are: (i) a basis for calculating a flux spectrum in order to obtain multigroup cross sections, and (ii) a method for solving the burnup equations. Under (i) particular attention is paid to the calculation of multigroup resonance cross sections and (ii) a simple and effective analytic technique is derived. Developments in the field of reactor physics which effect the calculation of multigroup data are presented. The physical model adopted to simplify the otherwise unmanageable equations is appropriate to a large recirculating fuel reactor operating under equilibrium conditions. The work is divided into essentially three parts (i) the basis of multigroup data, (ii) the calculation of multigroup data, and (iii) the solution of burnup and multigroup flux equations. Considering that neutron reactions are very dependent on neutron energy it is convenient to divide the energy range into three regions typified by completely different behavior. These are (a) the fast region—neutrons are produced from fission, (b) the resonance region—neutrons slow down in energy; and (c) the thermal region neutrons scatter up and down in energy until lost. Author (NSA)

N68-22560# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

TWO DB, A TWO-DIMENSIONAL DIFFUSION-BURNUP CODE FOR FAST REACTOR ANALYSIS

W. W. Little, Jr. and R. W. Hardie Jan. 1968 119 p refs
(Contract AT(45-1)-1830)
(BNWL-640) CFSTI: HC$3.00/MF$0.65

2DB is a two-dimensional (X–Y, R–Z, R–θ), multigroup diffusion code for use in fast reactor criticality and burnup analysis. All programming is in FORTRAN-IV. The code can be used to: compute k_{eff} and perform criticality searches on time absorption (α), reactor composition, and reactor dimensions by means of either a flux or an adjoint model; and compute material depletion rates. Since variable dimensioning is employed, no simple restrictions on problem complexity can be stated. However, in a 65K memory, the current version is nominally restricted to 50 energy groups. Running time (for a k_{eff} calculation) on a UNIVAC 1108 is about 2 minutes for a 30×30 mesh problem using 4 energy groups. Author (NSA)

N68-22564# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

USAEC-AECL COOPERATIVE PROGRAM, MONTHLY PROGRESS REPORT, JANUARY 1968

H. S. Hilborn, comp. 24 Jan. 1968 7 p
(Contract AT(07-2)-1)
(DPST-68-83-1) CFSTI: HC$3.00/MF$0.65

The schedule for measurements of the temperature coefficients of reactivity for organic-cooled lattices with simulated burned-up UO_2 fuels are presented. Of seven lattices containing simulated burned-up fuel, two with D_2O coolant are measured at temperatures up to 80°C and five organic-cooled lattices are measured at temperatures up to 250°C. Work on the HAMMER computer routine for physics measurements of fuel assemblies consisting of clusters of fuel rods is described. Author (NSA)

N68-22569# United Kingdom Atomic Energy Authority, Harwell (England).

DETERMINATION OF NEUTRON FLUX PARAMETERS FROM REACTION RATE DATA FOR THERMAL AND EPITHERMAL FLUX DETECTORS USED IN HARWELL REACTORS

E. D. Jones and P. Carter Mar. 1967 34 p refs
(AERE-M-1870) CFSTI: HC$3.00/MF$0.65

The Westcott formulas used for determination of thermal and epithermal fluxes are discussed. The required flux detectors are described. Limitations of experimental methods are discussed. An example of neutron flux measurement and data reduction at Harwell is given. Harwell data are presented in tabular form. NSA

N68-22584# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.

SUFFICIENT CONDITIONS FOR THE FLATTENING OF THERMAL NEUTRON FLUX AND SOME RELATED PROBLEMS (IN MULTIDIMENSIONAL GEOMETRIES)

R. Zezula Sep. 1967 11 p refs
(UJV-1900)

For a prescribed flux of thermal neutrons in the active zone of the reactor the distribution of the fuel concentration in the active zone is to be determined, which induces the given flux in the reactor core. The conditions (in the form of the boundary of the core active zone as well as the boundary of its reflector) are given which are sufficient for a unique solution of the problem and for the special case of flattened thermal neutron flux. The solution is formulated in the two-group diffusion approximation and for multidimensional geometries. Author (NSA)

N68-22587*# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

DESIGN, FABRICATION, AND FABRICATION EVALUATION OF HIGH TEMPERATURE FUEL PINS Final Report

R. L. Gulley 22 Apr. 1968 37 p refs
(Contract NAS3-7960)
(NASA-CR-72387) CFSTI: HC$3.00/MF$0.65 CSCL 18J

A total of twenty-seven molybdenum clad fuel pins were designed and fabricated. The purpose of the pins is to provide irradiation data needed for the design of full-length reactor fuel pins. Six of the fuel pins contained depleted uranium dioxide (UO_2); fourteen contained fully enriched UO_2; one contained depleted uranium nitride (UN); and six contained fully enriched UN. Author

N68-22589# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.

A SUFFICIENT CONDITION FOR THE FLATTENING OF THERMAL NEUTRON FLUX AND SOME RELATED PROBLEMS (IN ONE DIMENSIONAL GEOMETRIES)

R. Zezula Oct. 1967 14 p refs
(UJV-1904)

An expression is derived for the fuel concentration in the active zone of a reactor which induces a given flux in the core. The problem is formulated in the one-dimensional two-group diffusion approximation. A sufficient condition is given for the existence of a unique solution for the equation; the special case of a flattened thermal neutron flux is considered. A method of optimization of total output is described. NSA

N68-22593# Atomic Power Development Associates, Inc., Detroit, Mich.

TRANSFER FUNCTIONS FROM REACTIVITY PULSES GENERATED BY THE REGULATING ROD: ENRICO FERMI REACTOR

M. L. Batch and A. E. Klickman Dec. 1967 32 p refs
(APDA-NTS-14)

The measurement of reactor power and temperature responses to reactivity pulses generated by a single, trapezoidal movement of the regulating rod is discussed. Data obtained at three power levels are reduced by Fourier analysis of their time derivatives. Results are presented in terms of transfer functions between reactivity and power and between power and outlet temperatures. The advantages and disadvantages of this technique with respect to an alternate oscillator rod technique are examined. Author (NSA)

N68-22607# Scottish Research Reactor Centre, East Kilbride.

THERMAL NEUTRON SPECTRUM MEASUREMENTS AT A UTR-100 BEAM HOLE UTILISING A SLOW NEUTRON CHOPPER

Juan Oscar Saldano-Vega and J. Scobie Sep. 1967 39 p refs
(SRRC-21/67; NP-17261)

A simple slow neutron chopper of the Fermi type has been constructed. Measurements have been made of the energy spectrum of neutrons in a beam coming from the thermal column of the UTR-100 reactor, with various arrangements of the internal graphite. Author (NSA)

N68-22608# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik.

SUPPLEMENTARY MATERIAL TO THE REPORT NUCLEAR FUEL REQUIREMENTS AND COSTS OF VARIOUS REACTOR TYPES IN GERMANY, KFK 366 [ERGAENZENDES MATERIAL ZUM BERICHT KERNBRENNSTOFFBEDARF UND KOSTEN VERSCHIEDENER REAKTORTYPEN IN DEUTSCHLAND, KFK 366]

H. Gruemm, D. Gupta, W. Haefele, P. Jansen, M. Recker et al Sep. 1966 246 p refs Transl. into ENGLISH from Rept. KFK-466
(KFK-466; AEC-TR-6859) CFSTI: HC$3.00/MF$0.65

The background material used in the preparation of the report KFK-366 is presented. A detailed representation is given of the analytical and numerical calculation methods. The projects discussed are nuclear fuel reserves and price development, nuclear energy reserves and the economy of nuclear power plants, mathematical model transformation of nuclear fuel elements in combined reactor systems, cost calculation, fuel cycle for reactors, estimation of future energy needs, and characteristic reactor data. NSA

N68-22614# Atomic Power Development Associates, Inc., Detroit, Mich.

MEASUREMENT OF SOME REACTIVITY EFFECTS IN THE ENRICO FERMI REACTOR

G. T. Seeley, G. L. Ball, C. E. Branyan, R. E. Horne, R. E. Mueller et al Nov. 1967 76 p refs
(APDA-NTS-12)

Various nuclear tests are described which followed initial criticality of the Fermi fast breeder reactor. Measurements were made of the reactivity effects of the permanent neutron source, retractable neutron source, temporary instrument thimble, variation in flow rate of the primary coolant, and variation in pressure of cover gas in the primary system. Each test is reported separately and includes tabulated and graphical test data and discussions of purpose, apparatus and equipment, reactor plant conditions, measurements, experimental results and analysis, and conclusions. Author (NSA)

N68-22619# Los Alamos Scientific Lab., N. Mex.

A NUMERICAL STUDY OF EXCURSIONS IN UHTREX LOADED WITH STANDARD FUEL ELEMENTS

John C. Vigil Sep. 1967 15 p
(Contract W-7405-ENG-36)
(LA-3789) CFSTI: HC$3.00/MF$0.65

Preliminary numerical calculations of the response of the Ultra High Temperature Reactor Experiments (UHTREX) (loaded with standard fuel elements) to a wide range of reactivity inputs are presented. These calculations were done in support of a proposed series of excursion experiments whose main purpose is to determine the adequacy of calculational methods presently being used and to identify areas where the methods may need improvment. The experiments would provide a test of the calculated fuel temperature coefficient in UHTREX and would contribute to the testing of nonseparable space-time neutron kinetics codes now being developed.

These codes are needed for analysis of transients in UHTREX loaded with specially designed U–Th fuel elements and in other assemblies for transient studies in support of the High Temperature Gas-Cooled Reactor (HTGR) Program. Author (NSA)

N68-22621# Bettis Atomic Power Lab., Pittsburgh, Pa.
COMBINED SPACE-TIME SYNTHESIS WITH AXIALLY DISCONTINUOUS TRIAL FUNCTIONS. LWBR-LSBR DEVELOPMENT PROGRAM
J. B. Yasinsky Oct. 1967 71 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-736) CFSTI: HC$3.00/MF$0.65

A synthesis approximation model is developed for the solution of detailed three-dimensional space-time group diffusion problems. The proposed method uses two-dimensional spatial trial functions that exhibit a step-wise discontinuous behavior in the axial dimension. This feature permits switching of trial functions at specified axial locations. An explicit treatment of movable fuel regions is incorporated into the model. The synthesis equations are derived and a detailed description of the calculation of the necessary integrals and matrix elements is presented. Static numerical examples are presented which illustrate the selection of trial functions and the potential accuracy of the combined space-time synthesis model. Author (NSA)

N68-22638# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
DESCRIPTION OF IBM 360 COMPUTER PROGRAM FOR THE CALCULATION OF LIQUID COOLED 7-ROD CLUSTER FUEL ELEMENTS
W. Eifler, R. Nijsing, and J. Airola 1968 32 p ref
(EUR-3733.e)

An IBM 360 computer program for calculating the thermal performance of liquid cooled 7-rod cluster fuel elements is described, first for general features, then the single parts, and finally with a complete listing of the program. NSA

N68-22647# Chantiers de l'Atlantique Saint-Nazaire (France).
ON REACTOR MATERIALS Quarterly Report, 1 Jul.–30 Sep. 1967
9 Jan. 1968 5 p Transl. into ENGLISH from French
(Contract EURATOM-054-61-12-RDF)
(QR-10; EURAEC-1963; EUR-3772) CFSTI: HC$3.00/MF$0.65

Two new steels MANNESMANN WB 35 and vacuum degassed Mn Mo, were investigated. Impact strength decreases if tempering treatments are protracted, but impact strength is improved by brief tempering. Relaxation tests were terminated on steels in the normalized and normalized plus tempered states. The initial stress was equal to the elastic limit at ambient temperature increased by 2 hbar. Results are tabulated for 550 and 600°C. NSA

N68-22676# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
REACTOR PHYSICS MONTE CARLO APPLICATIONS
D. H. Thomsen 20 Sep. 1967 32 p refs Presented at Pacific Northwest Lab. Meeting, Richland, Wash., 20 Sep. 1967
(Contract AT(45-1)-1830)
(BNWL-SA-1513) CFSTI: HC$3.00/MF$0.65

Uses of Monte Carlo methods for reactor physics calculations are discussed; available computer codes are described. The codes are then listed by application. NSA

N68-22679# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
CONSIDERATIONS ON A DIRECT SPECTRAL METHOD OF IDENTIFICATION LINEAR SYSTEMS [CONSIDERAZIONI SU UN METODO SPETTRALE DIRETTO PER L'IDENTIFICAZIONE DEI SISTEMI LINEARI]
A. Garroni Brussels Feb. 1968 102 p refs In ITALIAN; ENGLISH summary
(EUR-3734.I) CFSTI: HC$3.00/MF$0.65

A direct harmonic method for power spectral density analysis is developed in this report. This method concerns the analysis of signals with finite mean value and is suitable for use on digital computers. The determination of the spectral resolution of measurement is achieved by mathematical way. Author

N68-22701# Commissariat a l'Energie Atomique, Saclay (France).
ISOTOPIC THERMOIONIC GENERATOR [GENERATEUR THERMOIONIQUE ISOTOPIQUE]
Max Clemot, Bernard Devin, and Jean-Paul Durand Dec. 1967 26 p refs In FRENCH
(CEA-R-3418) CFSTI: HC$3.00/MF$0.65

This report describes the general design of a thermionic direct-conversion space generator. The power source used is a radioisotope. Two radioisotopes are considered: Pu 238 and Cm 244. The system is made up of a heat pipe concentrating the thermal flux from the isotope to the emitter, and of a second heat pipe evacuating the waste heat from the collector to the outer wall used as radiating panel. Calculations are given in the particular case of a 100 electrical watts output power. Author

N68-22714# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
[SNAP-23A, PHASE 1] Quarterly Progress Report, 1 Sep.–30 Nov. 1967
S. Cerni 15 Dec. 1967 119 p refs
(Contract AT(30-1)-3800)
(WANL-3800-9; WANL-PR-(SS)-010) CFSTI: HC$3.00/MF$0.65

Progress is reported in SNAP-23A, the Advanced Terrestrial Radioisotope Power System. The radiator was received and put on thermal test. Tests indicate that the end-of-life power rejection can be accommodated at a maximum radiator base temperature of 150°F. The experimental mockup converter was assembled. Electron Beam welding was proposed for use in closure welding. Molybdenum–uranium, tungsten–nickel, and stainless steel shielding materials were evaluated for use with Sr and Co sources. Major components of the heat source are being assembled. Fabrication of Min-K-2000 thermal insulation was begun. The heat source support system and base assembly consisting of inner and outer insulation cans are ready for assembly. Heat source materials including Hastelloy-C/Ti/U–Mo/Cu/Inconel 718 and Hastelloy-C/Ta/U–Mo/W/Hastelloy C were tested. Properties of as cast U–Mo were determined. Thermal conductivity was determined for thermal insulation materials. A thermal analysis was performed to determine the effect of radiator damage on critical generator temperatures. It was found that about 75% of the radiator must be destroyed before a safety problem occurs. NSA

N68-22718# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
[SNAP-23A, PHASE 1] Quarterly Progress Report, 1 Jun.–31 Aug. 1967
S. Cerni 8 Aug. 1967 175 p refs
(Contract AT(30-1)-3800)
(WANL-3800-4; WANL-PR-(SS)-007) CFSTI: HC$3.00/MF$0.65

A design analysis was completed for replacing the lead-acid power supply in the Navy Acre Buoy with a SNAP-23A power supply. The buoy is used to provide upper water level temperature, pressure data, and surface weather information for the Anti-Submarine Warfare Environmental Prediction System (ASWEPS) for remote locations. Procurement of all major hardware for the Experimental Mockup System was initiated. Some delay was experienced in the delivery of this hardware. The radiator thermal test was scheduled. Delivery of the Experimental Mockup Converter, after acceptance testing and 500 hours of seasoning, is expected.

A schedule for the Prototype Mockup Converter was developed. The preliminary thermal definition will be based on the above radiator and converter tests along with results from bell jar and 10 couple tests. Final thermal definition will result from data obtained in the Experimental Mockup System test. On this basis, delivery of the protype Mockup Converter is expected in mid-April, 1968. Evaluation of the 100, 500, and 1,000 hour materials compatibility tests was completed. A problem with the use of titanium as the diffusion barrier material between the capsule and shield was identified. At 1400°F, it appears that nickel diffusion in titanium is very rapid, circumventing ghe function of the barrier. Initial tests up to 1800°F using both tantalum and tungsten as substitutes for titanium have indicated no problem with either of these materials. Based on these results, tantalum is being recommended as the diffusion barrier material. Author (NSA)

N68-22720# Commissariat a l'Energie Atomique, Cadarache (France).

AUTOMATIC CONTROL SYSTEM IN THE REACTOR PEGGY [SYSTEME DE PILOTAGE AUTOMATIQUE DU REACTEUR PEGGY]

Jean Bertrand, Robert Mourchon, David Da-Costa, and Christian Desandre-Avarre Dec. 1967 59 p In FRENCH
(CEA-R-3323) CFSTI: HC$3.00/MF$0.65

The equipment makes it possible for the reactor to attain a given power automatically and for the power to be maintained around this level. The principle of its operation consists in the changing from one power to another, at constant period, by means of a programmer tranforming a power-step request into a voltage variation which is linear with time and which represents the logarithm of the required power. The real power is compared continuously with the required power. Stabilization occurs automatically as soon as the difference between the reactor power and the required power diminishes to a few percent. Author

N68-22723# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

INFLUENCE OF IRON SEGREGATION ON THE MECHANICAL PROPERTIES OF REACTOR-GRADE HAFNIUM

C. D. Calhoun and J. R. Fiscia 15 Feb. 1967 10 p refs
(Contract W-31-109-ENG-52)
(KAPL-3360) CFSTI: HC$3.00/MF$0.65

A brief study of the effects of various heat treatments on the mechanical properties of reactor-grade hafnium has been accomplished. Three tensile specimens of reactor-grade hafnium were tested: one in the as-received condition and two in heat-treated conditions. The mechanical properties (yield strength, ultimate tensile strength, elongation, and reduction in area) were reduced significantly by the more severe of the two heat treatments investigated. The fracture surfaces of the three tensile specimens were studied by both light and electron microscopy. The results of these studies revealed that segregation of a solute had occurred at the grain boundaries. Electron microprobe analysis established the solute as iron. Author (NSA)

N68-22727# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

THE EXPERIMENTAL DETERMINATION OF FAST FISSION EFFECT IN GRAPHITE MODERATED, WATER COOLED, SLIGHTLY ENRICHED URANIUM LATTICES

D. F. Newman and M. P. Pervich 30 Nov. 1967 13 p refs
(Contract AT(45-1)-1830)
(BNWL-633) CFSTI: HC$3.00/MF$0.65

Measurements of fast fission effect in several graphite moderated water-cooled slightly enriched U lattices in the Physical Constants Test Reactor are discussed; results are given. Depleted and enriched U foils were used to measure activities; these activities are tabulated. NSA

N68-22728# Los Alamos Scientific Lab., N. Mex.

ENDF/B FORMAT REQUIREMENTS FOR SHIELDING APPLICATIONS

Donald J. Dudziak Apr. 1967 52 p refs
(Contract W-7405-ENG-36)
(LA-3801; ENDF-111) CFSTI: HC$3.00/MF$0.65

The present (April 1967) Evaluated Nuclear Data File/B (ENDF/B) format was designed primarily to satisfy the requirements of nuclear reactor core neutronics calculations. Extensions of the format specifications are proposed to include data of interest for shielding calculations for reactor and other applications. Alternate methods of presenting the necessary data are discussed, and the correspondence of ENDF/B to the United Kingdom Atomic Energy Authority Nuclear Data File (UK) is maintained wherever practical. In the case of photon interactions, detailed formats are recommended for cross sections for secondary angular, energy, and energy-angle distributions, and for incoherent and coherent scattering atomic form factors. Format recommendations for photon production data include those for photon angular distributions, photon production multiplicities, and photon energy-angle distributions. A listing of data on photon production in Na is included. Author (NSA)

N68-22747# Union Carbide Corp., Oak Ridge, Tenn. Gaseous Diffusion Plant.

FLUID-BED PROCESSING OF UNIRRADIATED URANIUM DIOXIDE REACTOR FUEL ON A SEMIWORKS SCALE

S. H. Smiley, J. H. Pashley, D. T. Stafford, and H. L. Kaufman [1967] 42 p refs Presented at 60th Ann. Meeting of the Am. Inst. of Chem. Engr., New York
(Contract W-7405-ENG-26)
(K-L-6142; CONF-671103-2) CFSTI: HC$3.00/MF$0.65

Volatility process development studies are discussed. A process flow diagram is given and described. The semiworks equipment and operating procedures are considered. Work showed that the HCl decladding and oxidation processes can be accomplished under controlled conditions. Oxidation of the UO_2 proceeded well at 480°C. Heat transfer from pellet bed to wall was quite poor compared to that in the fluidized-bed section. Proper setting and control of the superficial gas velocity through the bed was most important. The minimum required velocity was dependent on pellet bed depth. Attempts to separate the U_3O_8 from most of the alumina to allow transfer of the fuel material to another vessel for fluorination were only partly successful. NSA

N68-22748# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.

FISSION AS A METHOD OF ISOTOPE SYNTHESIS [DELENIE KAK METOD SINTEZA IZOTOPOV]

G. N. Flerov 1967 16 p refs In RUSSIAN
(JINR-P7-3617)

Perspectives of the synthesis of new isotopes are considered. Various methods of production of new isotopes such as fusion reactions, transfer reactions, and nuclear fission are considered. A possible synthesis of distant transuranium elements is discussed. Author (NSA)

N68-22760# Commissariat a l'Energie Atomique, Grenoble (France).

IRRADIATION OF UO_2 SHEATHED IN THE THICK TUBES—EFFECT OF INITIAL GAP [IRRADIATION D'OXYDE D'URANIUM EN GAINE RESISTANTE EFFET DU JEU DIAMETRAL INITIAL SUR LE COMPORTEMENT GLOBAL (PROGRAMME CC-7: 1ERE ET 2EME TRANCHES)]

Jean-Claude Janvier, Bruno de Bernardy de Sigoyer, and Roger Delmas Oct. 1967 77 p refs In FRENCH
(CEA-R-3358) CFSTI: HC$3.00/MF$0.65

Sixteen fuel elements made of thick Zircaloy tubes containing sintered UO_2 were irradiated to burnups of 3000 or 6000 MWd/t.

The specific power was continuously measured for each element. The initial diameter clearance was either 0.31 mm (free thermal expansion) or 0.12 mm (thermal expansion stress). Examination of irradiated fuel elements suggests that: (1) with the initial gap large, the fuel expands until it is in close contact with the sheath, and thermal resistance between fuel and sheath is higher than for stressed fuel; (2) a central hole and lenticular voids in movement toward the center by evaporation-condensation occur only in specimens with large initial gap; (3) some fission products are concentrated at a certain distance from the center, shown as bright annuli in β autoradiographs and occurring only in large-gap specimens; and (4) fission gas release is not affected by mechanical stresses applied to the fuel and always corresponds with the probable temperature distribution. K.W.

N68-22770# Commissariat a l'Energie Atomique, Saclay (France).

CAN RUPTURE DETECTOR FOR THE REACTOR OSIRIS [DETECTION DE RUPTURE DE GAINE DU REACTEUR OSIRIS]

Paul Douet and Jean Graftieaux Dec. 1967 57 p refs In FRENCH
(CEA-R-3328) CFSTI: HC$3.00/MF$0.65

The can rupture detection installation for the reactor Osiris consists of two parts. The first part gives the calculations which were carried out during the designing of the installation for estimating its performances. The second part is an account of the tests carried out for calibrating the installation after the first power-run of the reactor. The measured sensitivity and detection threshold (16 counts/sec for 1 cm^2 of U_{nat} and 2 cm^2 of U_{nat}) are fairly close to the calculated values (12 counts/sec for 1 cm^2 U_{nat} and 1 to 2 cm^2 U_{nat}). Author

N68-22783# Combustion Engineering, Inc., Windsor, Conn. Nuclear Div.

FEASIBILITY STUDY OF VARIOUS CALCULATIONAL MODELS AND EVALUATION OF THE EXPECTED ACCURACIES OF PREDICTED ISOTOPIC CONCENTRATIONS IN FAST REACTOR CORES

Richard Kern and Albert T. Shesler 12 May 1967 29 p refs
(Contract AT(38-1)-428)
(CEND-308) CFSTI: HC$3.00/MF$0.65

The results of the feasibility study and evaluation of the accuracies of predicted isotopic concentrations for fast reactors are presented. Results presented include: descriptions of various models along comparisons of calculational versus experimental results obtainable with each; evaluation of the accuracies of predicted isotopic concentrations of the various models; and recommendations for setting up a method similar to ISOCHECK by which the isotopic content in operating fuel elements of fast reactors can be checked. Author (NSA)

N38-22784# Combustion Engineering, Inc., Windsor, Conn. Nuclear Div.

CETIC: A COMPUTER CODE PACKAGE FOR CALCULATING HEAVY-ISOTOPE CONTENT IN REACTORS FOR USE WITH ISOCHECK METHOD

Richard Kern, Ann Forbes, and Thomas Hencey 5 May 1967 88 p refs
(Contract AT(38-1)-428)
(CEND-300) CFSTI: HC$3.00/MF$0.65

The results of the development of the CETIC computer code package to permit its direct application for calculating the heavy-isotope content in reactors for which the ISOCHECK Method has been set up are presented. The results include: a description of each part of the package along with the equations used to compute the isotopic content; a detailed description of the input and output from each part with specific examples; and listings of the FORTRAN IV source decks used to compile each part of the package. Sufficient information is supplied to enable correct punching of all cards and to enable the user to make the proper interpretation of all the input data and the available options. Author (NSA)

N68-22792# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

PROCEEDINGS OF AEC INDUSTRY MEETING ON IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS, USAEC HEADQUARTERS, GERMANTOWN, MARYLAND, 18 JULY 1967

A. L. Bement and L. E. Steele Dec. 1967 91 p refs
(BNWL-609; CONF-670721) CFSTI: HC$3.00/MF$0.65

The working committees for the Irradiation Effects on Reactor Structural Materials Programs are discussed; committee members are outlined. Efforts and results of the BNWL program are given; Argonne contributions, especially in the field of LMFBR materials development, are presented; the BMI programs are described; Idaho Nuclear Corporation contributions are summarized; fracture toughness investigations for A302B steels are presented in some detail. The development of fast breeder reactor materials is discussed. Discussions by industry, utilities, and professional societies are presented. NSA

N68-22796# AEG-Kernenergieanlagen, Frankfurt am Main (West Germany).

AEG SUPERHEAT REACTOR R AND D PROGRAM [HEISSDAMPFREAKTOR KAHL FORSCHUNGS UND ENTWICKLUNGS PROGRAM. VIERTELJAHRESBERICHT APRIL–JUNI 1967] Quarterly Report, Apr.–Jun. 1967

15 Dec. 1967 45 p In GERMAN
(AEG-E-31-873; QR-10)

Irradiation testing of boiling water superheater fuel elements in the VAK reactor is discussed. Results of postirradiation examination of fuel elements which were in VAK during two large temperature excursions are given. Development of duplex tubes for end plugs of advanced Zr fuel elements is discussed. Results of the testing of seals between the superheater element and the superheated steam collector are discussed briefly. Details of postirradiation examination of small-type reactor superheater fuel elements are included. NSA

N68-22802# Los Alamos Scientific Lab., N. Mex.

DESCRIPTION OF EXPERIMENTS LASL-36, -37, -38, -39, -40, -41, AND -42 AND EVALUATION OF THE HAZARDS INVOLVED WITH THEIR IRRADIATION IN ERB-2

John O. Barner 18 Aug. 1967 27 p refs
(Contract W-7405-ENG-36)
(LA-3768) CFSTI: HC$3.00/MF$0.65

A description of fuel and cladding irradiation experiments for the LASL fast breeder experimental program is given; the experiment capsules were irradiated in the EBR-II. Operating conditions are tabulated for the capsules; radiation damage to clad materials is given; detailed data for fuel material are presented. Heating rate calculations are given; loop stresses are presented as a function of fission gas pressure. Decay heat is tabulated as a function of time for each capsule; fission product buildup is given. NSA

N68-22833# Oak Ridge National Lab., Tenn.

ATOMIC ENERGY COMMISSARIAT: FAST NEUTRONS First Trimester Report

1967 96 p Transl. into ENGLISH from French
(ORNL-TR-1764) CFSTI: HC$3.00/MF$0.65

Malfunctions, prior to startup, of the Rapsodie primary pumps are discussed; subsequent primary loop testing is described. Control rod testing is outlined. Loading operations and approach-to-critical are discussed; criticality measurements are described. Low power measurements are detailed. Approach-to-power reactor dynamics are shown. Basic neutron physics measurements made in the HARMONIE critical assembly are outlined. Criticality studies in the plutonium fueled MASURCA critical assembly are described. Calibration of MASURCA control rods is described. Calculational and model studies of the Phenix core are outlined. Research on fuels and irradiation of prototype oxide, carbides and nitrides is discussed. Results of mechanical properties studies on cladding materials are presented; radiation effects studies are summarized. Sodium technology studies are outlined. Results of calculations of pressures due to sodium-water reactions are shown. Reactor Safety tests are summarized. NSA

N68-22836# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.

AEC FUELS AND MATERIALS DEVELOPMENT PROGRAM

29 Dec. 1967 144 p
(Contract AT(40-1)-2847)
(GEMP-1002; PR-71) CFSTI: HC$3.00/MF$0.65

Summary data are presented on work conducted in reactor materials development. Included are (1) radiation effects on fast reactor cladding and structural materials, (2) physical and mechanical properties on reactor materials, (3) physico-chemical studies of clad uranium oxides on potential meltdown environments, (4) refractory metal alloy research and development, (5) physical metallurgy of refractory metal alloys, (6) advanced long-life reactor fuel cladding and structural materials development, (7) evaluation of the plastic fatigue properties of heat resistant alloys, (8) advanced pressure vessel materials, and (9) high temperature thermocouple and electrical research. B.S.D.

N68-22839# Institutt for Atomenergi, Kjeller (Norway).

SURVEY OF ACTIVITIES, 1966

Bjarne Aabakken, ed. Mar. 1967 134 p refs
(KR-116)

Research progress is reported under the following topics: reactor dynamics, power reactor studies, marine reactor studies, engineering development, reactor physics, digital and analog computers, reactors, neutron physics, K-1 fuel reprocessing project, radiochemistry, operation of the waste treatment plant, reactor chemistry, analysis, UO_2 metallurgy, fuel element development and fabrication, material techniques and testing, K-4 corrosion project, isotope production and development, the Netherlands–Norwegian Reactor School, safety work, and health physics. NSA

N68-22855# Argonne National Lab., Ill. Metallurgy Div.

THE DEVELOPMENT OF A DESIGN AND FABRICATION METHOD FOR PLUTONIUM-BEARING ZERO-POWER REACTOR FUEL ELEMENTS

A. B. Shuck, H. F. Jelinek, A. G. Hins, N. J. Carson, Jr., A. A. Denst et al Aug. 1967 92 p refs
(ANL-7313) CFSTI: HC$3.00/MF$0.65

Approximately 20,000 Pu-containing fuel elements are required for physics experiments and mockup of large-scale fast reactors. The method selected for development was casting the alloy into refractory-coated carbon molds to form semiprecision bars from which the core plates were machined. Although hard and brittle, the alloy is machinable at room temperature with WC-tipped tools. Jacket were fabricated from precisely formed, Type 304L stainless steel, rectangular sleeves and end plugs that were welded into the sleeves. Techniques that do not radioactively contaminate the outer surfaces were developed to load the core plates into the jackets. The final weld was made with the end plugs placed against the ends of the cores. This provided a finished element that expands immediately when heated by a reactor power excursion. The proposed method of fuel-element manufacture was tested by the pilot fabrication of fuel elements and the investigation was extended to a study of fabrication costs for manufacture of production lot of fuel elements. The work culminated in a specification to be used for the fabrication of U–Pu–Mo alloy fuel elements for the Zero Power Plutonium Reactor and for ZPR-6 and -9 experiments. Author (NSA)

N68-22898# Sandia Corp., Albuquerque, N. Mex. Space Isotope Power Dept.

NEW DEVELOPMENTS IN THE SPACE ISOTOPE POWER PROGRAM

Arthur J. Clark, Jr. Dec. 1967 32 p Presented at 5th Space Congr., Cocoa Beach, Fla.
(Contract AT(29-1)-789)
(SC-DC-67-2119; CONF-680301-1) CFSTI: HC$3.00/MF$0.65

The nedd for adequate sources of electric power in space missions is discussed. The development and performance or anticipated performance of SNAP-3, 9A, 19B, 27, 29 and a large heat source to provide the thermal input for the Brayton cycle power converter are described. Research on thermal insulation is also reviewed. NSA

N68-22909# California Univ., Livermore. Lawrence Radiation Lab.

EFFECT OF CORE VOIDS ON SPECIFIC MASS OF REFLECTOR-CONTROLLED REACTORS: IMPLICATIONS FOR CERMET FUELS

W. N. Podney 16 Nov. 1967 43 p ref
(Contract W-7405-ENG-48)
(UCID-15268) CFSTI: HC$3.00/MF$0.65

It has been generally accepted that the largest fuel volume fraction attainable in a reactor design gives the smallest mass per unit power for a reactor system composed of a reactor core, neutron reflector, and shadow shield. It is shown that on the basis of one-energy-group diffusion theory that for reactor systems of the SPR-6 class (50,000 MW-days) the specific mass can be reduced by as much as a factor of two by adding voids to the reactor core. It is then shown that using a cermet fuel to reduce fuel element swelling caused by entrained fission product gases increases the specific mass of such reactor systems. In no case is it reasonable to expect a reduction in specific mass to result from the use of a cermet fuel. Author (NSA)

N68-22914# Battelle Memorial Inst., Columbus, Ohio.

AN EVALUATION OF THE APPLICABILITY OF EXISTING DATA TO THE ANALYTICAL DESCRIPTION OF A NUCLEAR-REACTOR ACCIDENT Quarterly Progress Report, Oct.–Dec. 1967

David L. Morrison, Wayne A. Carbiener, Robert L. Ritzman, Joachim N. Blutreich, William E. Clark et al 1 Jan. 1968 28 p refs
(Contract W-7405-ENG-92)
(BMI-1825) CFSTI: HC$3.00/MF$0.65

The consequences of a loss-of-coolant, or blowdown, accident in boiling-water reactors were investigated. Calculations were performed to provide an analytical description of the thermal and hydraulic conditions in the core and the fission-product behavior following such accidents. NSA

N68-22936# United Kingdom Atomic Energy Authority, Harwell (England).

NEUTRON MEASUREMENTS AROUND NUCLEAR REACTORS

J. W. Leake and A. K. Burt Mar. 1967 9 p refs
(AERE-M-1848) CFSTI: HC$3.00/MF$0.65

Measurement of the neutron dose equivalent rate at several locations had indicated large differences between the Andersson–Braun detector and the 0072 spherical dose detector (Leake monitor). Part of the discrepancy was attributed to the response of the 0072 monitor to high energy gamma radiation

(>3.5 MeV) and part to the differences in the responses of the two detectors when exposed to a narrow beam of neutrons. Observations were made at a number of locations and in the presence of narrow beams of neutrons. The gamma-ray spectrum was analyzed and the response of the 0072 monitor corrected for the high energy gamma dose rate. The measurements showed that where narrow beams of neutrons occur the 0072 monitor will almost always give a higher reading than the dose equivalent rate measured with an Andersson–Braun detector. In a narrow beam of neutrons both monitors underestimate the peak dose equivalent rate because they give a value which is a function of the average value of the neutron flux density over the volume of the detector. The levels of high energy gamma radiation measured were significant, but were too low to account for the larger discrepancies between the 0072 and the Andersson–Braun monitors. It is concluded that the large differences between the 0072 and the Andersson–Braun counter which have been reported are mainly due to the effects of neutron streaming. Author (NSA)

N68-22941# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.

MEASUREMENT OF THE DIFFUSION PARAMETERS IN A GRAPHITE MEDIUM WITH CHANNELS BY THE PULSE METHOD [IZMERENIE DIFFUZIONNYKH PARAMETROV V GRAFITOVOI SREDE S KANALAMI IMPUL'SNYM METODOM]

I. F. Zherzherun 1967 20 p refs In RUSSIAN
(IAE-1363)

Experiments for the study of the diffusion of neutrons in graphite media having a square lattice of cylindrical channels of radius 0.8 cm and spacing of 2.0 cm and in solid graphite are described. The decay constant λ was measured in graphite blocks of different dimensions. The decay constant was calculated from the measurement of the decay of the neutron density with time. The analysis of the dependence of λ on the geometric parameter B^2 for solid graphite and on the longitudinal $B_{\parallel}^2$ and on the transverse $B_{\perp}^2$ parameters for graphite with channels gave the possibility of obtaining the diffusion coefficient and diffusion cooling for this decay and relations between them. The ratio of the coefficients $D_{\parallel}/D_0$ and $D_{\perp}/D_0$ was compared with calculations by Behrens theory. Author (NSA)

N68-22943# Bettis Atomic Power Lab., West Mifflin, Pa.

THE THERMAL CONDUCTIVITY OF URANIUM DIOXIDE AT VERY HIGH TEMPERATURE GRADIENTS

E. Patrassi 1967 16 p refs Transl. into ENGLISH from J. Nucl. Mater. (Netherlands), v. 22, 1967 p 311–319
(WAPO-TRANS-82) CFSTI: HC$3.00/MF$0.65

A method was developed that permitted the measurement of the thermal conductivity of UO_2 over a large temperature range ($300°C < T < 2000°C$) with variable, controlled temperature gradients ($30°C/cm < dT/dx < 5000°C/cm$). The accuracy was a function of the temperature and temperature gradient varying between ±3 to ±8%. The measurements show that the thermal conductivity of UO_2, K, is a function of the temperature and the temperature gradient. The dependence is reversible as long as a specimen develops no cracks. The change in elastic properties which result from the thermal stresses produced in a thermal gradient may be responsible for this behavior. Large thermal gradients can also be expected to disturb the uniformity of lattice vibrations. The thermal conductivity exhibits a maximum at 1050°C. Large temperature gradients can also be responsible for this phenomenon. It is possible to correlate this result with the zero point of the Seebeck coefficient, as measured by other experimenters, since the electronic contribution to the thermal conductivity can exhibit a maximum in this temperature range. Measurements made in the high-temperature region ($1200°C < T < 2000°C$) with large temperature gradients (5000°C/cm) show agreement with conductivity values measured in-pile. In this connection, the specimens employed exhibit columnar grains similar to those which appear in irradiated samples. This indicates that it is possible to simulate certain in-pile thermal conditions by this technique. Author (NSA)

N68-22954# Oak Ridge National Lab., Tenn.

ZERO-POWER PHYSICS EXPERIMENTS ON THE MOLTEN-SALT REACTOR EXPERIMENT

B. E. Prince, S. J. Ball, J. R. Engel, P. N. Haubenreich, and T. W. Kerlin Feb. 1968 60 p refs
(Contract W-7405-ENG-26)
(ORNL-4233) CFSTI: HC$3.00/MF$0.65

The techniques and results of a program of experiments designed to measure the important neutronic characteristics of the MSRE, under conditions of negligible nuclear heat generation are presented. The program includes the initial critical ^{235}U loading, the control-rod calibration (period-differential worth and rod drop-integral worth measurements), determinations of the reactivity loss due to fuel circulation, the "static" reactivity coefficient of excess ^{235}U concentration and isothermal core temperature, the fuel salt temperature reactivity coefficient, the pressure effects on reactivity, and a series of system dynamics tests (frequency response, transient flow, and neutron flux noise measurements). These measurements form much of the experimental baseline for current evaluation of the nuclear operation at full power. Discussions of the comparisons of the measurement results with the corresponding neutronic characteristics calculated from theoretical models are presented. Author (NSA)

N68-22960# Argonne National Lab., Ill.

A THERMOMECHANICAL CORE ANALYSIS "DANGER SPOTS" AND "PLASTIC FUEL"

G. Karsten Dec. 1967 21 p refs Transl. into ENGLISH from Inst. Angew. Reaktorphys. Paper BE/4-Notiz, no. 72
(ANL-TRANS-558) CFSTI: HC$3.00/MF$0.65

A formula for calculation of the maximum burnup of a fuel element is analyzed. The formula is based on the assumption that the maximum burnup is attained when all the pore volume and empty volume in the fabricated element has been filled. The assumption was made that these volumes are displaceable over the entire element. An assumption that there is a serious interaction between the fuel and cladding under conditions of uneven burnup leads to the conclusion that "danger spots" are produced in the half of the core where the coolant inlet is located. NSA

N68-22996# South Carolina Univ., Columbia. Dept. of Physics and Astronomy.

ANTINEUTRINO FLUX GEOMETRY FACTORS FOR A SAVANNAH RIVER PRODUCTION REACTOR

F. T. Avignone and C. W. Darden, III Dec. 1967 32 p refs
(Contract AT(38-1)-474)
(SRO-142) CFSTI: HC$3.00/MF$0.65

The geometrical factors needed to calculate the flux of antineutrinos at a number of points near a Savannah River Production Reactor were computed and tabulated. Analytical expressions for both the vertical and radial dependence of the normalized power density functions were assumed. The geometrical factors are tabulated for nine different shapes of the normalized power density function by varying two parameters. Author (NSA)

N68-23006# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.

FISSION PRODUCT ABSORPTION IN THERMAL REACTORS

W. H. Walker [1966] 17 p refs
(AECL-2497; CN-23/1) CFSTI: HC$3.00/MF$0.65

A discussion of fission product buildup in thermal reactors is given. Yield measurements, cross sections, resonance integral determination, and fission product absorption are discussed. The most important fission products which are produced are listed with characteristic parameters for each. NSA

N68-23007# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.

EXPERIENCE WITH CANDU REACTORS AND THEIR POTENTIAL

A. M. Aikin Nov. 1967 13 p refs Presented at the IAEA Conf. on Prospects and Probl. of Nucl. Power Appl. in Developing Countries, Santiago, 4–8 Dec. 1967
(AECL-2795; CONF-671210-1) CFSTI: HC$3.00/MF$0.65

Improvements and changes being developed in CANDU reactors are examined together with economics and possibilities for the future. NPD has successfully demonstrated the CANDU–PHW (pressurized heavy water) reactor concept. Though early operating experience of the Douglas Point PHW-200 MWe reactor was beset with mechanical problems, this power source is expected to meet the targets set. Four similar 500 MWe units on one site are under construction at Pickering. Reactors of the same type are being built in India and Pakistan. The BLW (boiling light water) 250 MWe reactor concept has been tested in large scale loops and construction has begun at Gentilly in Quebec. WR-1, an organic cooled reactor, has performed so well that interest in this system has been revived. Fuel costs are now less than 0.6 mill/kWh without Pu credit. New materials and fuel cycles are being developed. The capital costs of large size plants are competitive with other systems but higher in small sizes. Cost reduction studies on small plants are underway. Author (NSA)

N68-23008# Atomic Energy of Canada, Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.

CURRENT STATUS OF CANADIAN ORGANIC COOLED REACTOR TECHNOLOGY

A. J. Mooradian, R. F. S. Robertson, S. R. Hatcher, R. G. Hart, D. R. Tegart et al Sep. 1967 20 p refs Presented at the IAEA Symp. on Heavy Water Power Reactors, Vienna, 11–15 Sep. 1967
(AECL-2943; SM-99/33; CONF-670917-11) CFSTI: HC $3.00/MF $0.65

Developments in the operation of the Canadian organic cooled D_2O moderated pressure tube reactor WR-1 are presented. The operation of the WR-1 (Whiteshell Reactor) and supporting development programs are discussed. Coolant technology is detailed; pressure tube and fuel materials are analyzed. NSA

N68-23017# Commissariat a l'Energie Atomique, Saclay (France).

CRITICAL EXPERIMENTS CARRIED OUT WITH A HOMOGENEOUS PLUTONIUM SOLUTION. EXPERIMENTAL RESULTS. THEORETICAL INTERPRETATIONS [EXPERIENCES DE CRITICITE REALISEES AVEC UNE SOLUTION HOMOGENE DE PLUTONIUM—RESULTATS EXPERIMENTAUX—INTERPRETATIONS THEORIQUES]

Jean-Claude Bouly, Robert Caizergues, Edovard Deilgat, Michel Houelle, and Pierre Lecorche Dec. 1967 91 p refs In FRENCH
(CEA-R-3367) CFSTI: HC$3.00/MF$0.65

Experimental and theoretical studies on cylinders and plates of solution are summarized as follows: (1) results obtained on critical heights of solutions; (2) effects of nitrogen, introduced in the form of the ion NO_3, on the reactivity of fissionable media; (3) effects of 240 plutonium 94 on the reactivity of these media; and (4) effects of the dimensions of the inner cavity of annular cylinders and of the moderator which may be introduced. Simple results were obtained which are easy to apply. An extrapolation to other geometries is made. K.W.

N68-23035# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

REACTIVITY WORTH OF A CENTRAL SAFETY ROD WITH AND WITHOUT AN INTERNAL SCATTERER

V. O. Uotinen and A. L. Pitner Feb. 1968 21 p refs
(Contract AT(45-1)-1830)
(BNWL-618) CFSTI: HC$3.00/MF$0.65

An experiment has been performed on the D_2O-moderated Plutonium Recycle Critical Facility (PRCF) to determine the increase in the negative reactivity worth of a hollow Cd safety rod when a scattering material (Lucite) is placed inside the safety rod. The experiment was conducted to investigate the feasibility of increasing the worth of the PRCF safety system for special purposes, and to evaluate calculational methods of determining the worth of safety rods with internal scattering. The PRCF was loaded with a two-zone configuration of 1.8 wt % Pu–Al and natural UO_2, and the safety rod was located in a central fuel channel. Results of worth measurements are presented. Author (NSA)

N68-23043# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

FAST BREEDER REACTORS WITH DIRECT BOILING COOLANTS [BYSTRYE BRIDERY NEPOSREDSTVENNO OKHLAZHDAEMYE KIPYASHCHIM TEPLONOSITELEM]

Mechislav Taube 1967 71 p refs In RUSSIAN; ENGLISH summary
(INR-842/C)

Classification system of fast nuclear reactors is discussed. Concepts of fast breeders fueled with fused chlorides of U, Pu, Na(K), and cooled directly with boiling coolant are discussed. The SAWA homogeneous boiling reactor with AlCl as coolant, and the WARS reactor boiling heterogeneously with Hg_{met} as boiling coolant are described. Some preliminary calculations for 1000 MW(t) reactors of both types were performed. Safety conditions and specific "bubble effect" are discussed. Some remarks about the fuel recycling are given. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N68-21848# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France). Faculte des Sciences.

ON THE FUNCTIONAL FORMALISM IN QUANTUM FIELD THEORY

M. Dubois-Violette Mar. 1968 14 p refs
(TH/68/6) CFSTI: $3.00

A formalism is developed to deal with c-number generating functionals of quantum field theory. The general unitary relations and Schwinger equations are investigated using this formalism. Then, the formalism is used to construct a functional formulation of quantum field theory, in which state vectors are described by functionals, and field operators by functional differential operators. This formulation is in complete analogy with the wave-mechanics formulation of nonrelativistic quantum theory, in which state vectors are described by functions and observables by differential operators. Finally the case of the electromagnetic field is investigated. Author

N68-21849# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

REVIEWS OF THE RELATIVISTIC ASPECTS OF THE THREE-BODY PROBLEM: PRACTICAL COMPUTATIONS FORM FACTORS IN S-MATRIX THEORY

R. Omnes and J. L. Basdevant Mar. 1968 35 p refs Presented at the Intern. Conf., Houston, Tex., Apr. 1968
(Rept.-68/10) CFSTI: $3.00

A review of the practical approaches to relativistic three-body calculations is presented. Some attention is given to the limitations of the relativistic versions of the Faddeev equation and the separable approximation. The practical results obtained with the three-pion system by Basdevant and Kreps are discussed and compared with the experimental data. The ND^{-1} approach to the three-body problem by Mandelstam is reviewed. For illustration and simplicity, the problem of the computation of form factors is given as an example. It is stated, and this is a new result, that the equations are self-contained. This implies that the Frazer–Fulco analysis of isovector form-factors can be extended to the isoscalar form-factors. Finally one gives the results of a recent extension of the same technique to the N-body problem. Here the conclusions are negative: linear equations in one variable for form factors do not seem to exist. Some consequences are derived which bear upon the existence, unicity and asymptotic behavior of current form factors. Author

N68-21895*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SELECTED BIBLIOGRAPHY AND ABSTRACTS OF HIGH-TEMPERATURE OPTICAL PROPERTIES AND THEIR MEASUREMENT

D. W. Gates 8 Dec. 1967 37 p refs
(NASA-TM-X-53679) CFSTI: HC$3.00/MF$0.65 CSCL 20F

This bibliography was prepared to list the sources containing emissivity and absorptivity data on materials at extremely high temperatures. Experimental work to determine data in these listings was done using both the absolute and comparative methods for obtaining values. In the absolute method the values were calculated by knowing the power input and losses and the resulting surface temperature of the sample. In the comparative method the values were obtained by a comparison of sample and blackbody radiation at the same temperature. One very difficult problem in comparing results in these sources is to recognize the possible error in measurements made at high temperatures, especially errors in determining temperatures of samples above 1500°K. The sample temperature and degree of specularity must be known, but present values are neither accurate nor reliable when experiments are duplicated. Accurate data for emission and absorption in the optical wavelength band of the spectrum for materials at high temperatures are necessary in heat transfer analyses and radiometric instrumentation in satellites. Emphasis in this bibliography was placed on listings giving information about the instrumentation used in the experimental work. Author

N68-21900*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.

A LOGICAL CONTRADICTION FROM TACHYONS

Peter D. Noerdlinger Dec. 1967 11 p refs
(Grant NsG-233-62)
(NASA-CR-94241; Rept.-67-73) CFSTI: HC $3.00/MF $0.65 CSCL 20J

It is shown that the existence of particles that can travel faster than the speed of light (tachyons) would lead to the possibility of creating physical experiments in which any outcome would contradict a recently proposed hypothesis. Author

N68-21961 Iowa State Univ. of Science and Technology, Ames.

PERTURBATION THEORY APPLIED TO A VARIATIONAL ANALOGY BETWEEN REACTOR THEORY AND CLASSICAL MECHANICS

Richard Eyring Turley (Ph.D. Thesis) 1966 66 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-5631

An operator-type perturbation method is used to solve perturbation problems associated with the neutron diffusion equation. The method, related to the hybrid Schrodinger–Heisenberg perturbation method of quantum mechanics which is an operator or transformation method, determines the shape of the perturbed flux and its magnitude. Inasmuch as this method utilizes the stationary property of the Lagrangian it inherently contains the reactivity or eigenvalue solution. The calculus of variations is used to show that a certain Lagrangian is stationary and that the neutron diffusion equation can be derived from it. The perturbed solution is obtained by adding to the unperturbed solution a series expansion of the known solution. Two applications in one-group neutron diffusion theory are illustrated. Dissert. Abstr.

N68-22001* Informatics, Inc., Los Angeles, Calif.

FORTRAN OPTICAL LENS DESIGN PROGRAM. VOLUME 3: PROGRAM ORGANIZATION AND DESCRIPTION

Paul J. Firnett and Leslie A. Wilson 19 Feb. 1968 545 p
Prepared for JPL
(Contract NAS7-100)
(NASA-CR-94313; TR-67-700-10-2, V. 3) CFSTI: $3.00 CSCL 20F

Implementation of a model into a computer program is shown in a detailed description of the organization and structure for the FORTRAN optical lens design program. The overlay diagram is presented and the characteristics of each of the subroutines are discussed. Interlink and intralink aspects of labeled common are detailed, as are links 0 to 8 of the program. A section of program modification covers adding capability, adding new input, changing the dimensions of E, and conversion problems. The storage map shown is essentially an overlay diagram with storage requirement information, and a source program listing is included. M.W.R.

N68-22023 Illinois Univ., Urbana.

ON THE CONSTRUCTION OF MACROSCOPICALLY LOCAL RELATIVISTIC QUANTUM THEORIES

Jon Roland Nance (Ph.D. Thesis) 1966 70 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-6685

The problem of providing a physical interpretation of a relativistic quantum theory is discussed. It is shown that a single operator corresponding to a localized measurement on the states of the theory is sufficient for a significant part (perhaps all) of this interpretation. The application of this method of interpretation to the relativistic quantum theory defined on the representation space of an irreducible representation of a higher symmetry group containing the Poincaré group is discussed. This problem is specialized to the problem of constructing a model relativistic quantum theory of a certain type. The structure of the model permits the construction of the generators to be approached by successively satisfying their structure relations in each of the spaces specified by the eigenvalues of the free field particle number operator. Dissert. Abstr.

N68-22061 General Electric Co., Philadelphia, Pa. Missile and Space Div.

UNIFICATION AND CLASSIFICATION OF STABILITY CONCEPTS OF DYNAMICAL SYSTEMS

Demetrios G. Magiros 4 Jul. 1967 21 p refs Presented at the 7th Intern. Symp. on Space Technol. and Sci., Tokyo, May 1967
(Doc.-67SD261)

By an appropriate mathematical interpretation of the perturbations, either of the initial conditions or of the dynamical systems themselves, one can distinguish three different basic concepts of stability of dynamical systems, namely the concepts of stability in the Liapunov, Poincaré and Lagrange sense. All other concepts of stability are subcases of the above basic ones. By the above one has a "classification of the concepts of stability". Three basic concepts of stability for sudden or persistent perturbations of dynamical systems, although different in their nature, can be expressed with the same analytical conditions, by defining and using in these conditions the Liapunov, Poincaré and Lagrange distances, when one can speak about "unification of the concepts of stability". The above classification and unification of the concepts of stability may be the source of new results concerning stability. Author

N68-22105 Utah Univ., Salt Lake City.

MEASUREMENT OF THE POTENTIAL OF ZERO CHARGE OF SOLID ELECTRODES

Richard Scott Perkins (Ph.D. Thesis) 1967 94 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-1202

A method analogous to the streaming mercury electrode has been developed for the measurement of the potential of zero charge of solid electrodes. The method utilizes a high speed scraping device to continuously renew the surface of the solid electrode. The method was tested for solid gallium for which results were obtained that agreed closely with those of liquid gallium. Experimental results lead to the conclusion that the potential of zero charge has also been measured for gold and silver. An expression relating the potential of zero charge and work function was derived and tested using the values of zero charge found with the new method. Dissert. Abstr.

N68-22108 California Inst. of Tech., Pasadena.

MULTIPLE SCATTERING OF ACOUSTICAL WAVES

David James Mc Closkey (Ph.D. Thesis) 1967 124 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-6067

The general theory of the multiple scattering of acoustical waves by a random distribution of isotropic point scatters is considered. Configurational averages are taken of the equations of multiple scattering and integral equations governing these configurational averages are obtained; the physical consequences of these equations are examined in detail. A complete theoretical picture is obtained of the propagation of the coherent and incoherent radiation and of the connections between the coherent and incoherent contributions to the average sound intensity and current. The problem of the transmission of sound from a plane sound source into a scattering half-space is studied. The reflection of an incident plane wave, inclined at an arbitrary angle to a scattering half-space is considered; an expression for the reflection coefficient, including both the coherent and incoherent reflection of sound, is obtained. The foregoing results are then applied to sound propagation in a liquid containing a large number of small gas bubbles. Dissert. Abstr.

N68-22116* Informatics, Inc., Los Angeles, Calif.

FORTRAN OPTICAL LENS DESIGN PROGRAM. VOLUME 2: USER'S MANUAL

Paul J. Firnett and Leslie A. Wilson 16 Oct. 1967 203 p
Prepared for JPL
(Contracts NAS7-100; JPL-951495)
(NASA-CR-94311; TR-67-700-10-2, V. 2) CFSTI: $3.00 CSCL 20F

A user's manual is presented on the Fortran optical lens design program. A description of the output type and content is given along with an explanation of how to set the case deck. Particular emphasis is placed on the input description, and the organization and content of a case deck is summarized. Examples are given in order to demonstrate the capabilities of the program. B.S.D.

N68-22127# Aeronautical Research Council (Gt. Brit.)

SOME NUMERICAL CALCULATIONS FOR AN ELECTRIC ARC IN A CYLINDRICAL TUBE

P. F. Hodnett (Leeds Univ.) 13 Sep. 1967 32 p refs
(ARC-23426) CFSTI: HC $3.00/MF $0.65

Numerical calculations of the properties of a static arc in a circular cylindrical tube are given. Radiation is taken into account in a simplified way, and the assumed variations with temperature of the radiated power density, electric conductivity and thermal conductivity represent an attempt to cover the whole range of conditions from a weakly ionized gas to a fully ionized gas. One indication from the calculations is that an arc is heat-conduction dominated at very high currents. Author (ESRO)

N68-22129 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

JOURNAL OF APPLIED SPECTROSCOPY

11 Sep. 1967 17 p refs Transl. into ENGLISH from Zh. Prikl. Spektroskopii, v. 4, no. 2, 1966 p 134–141 and 176–179
(FTD-MT-66-87; AD-666241)

CONTENTS:

1. RESONANCE FORCED COMBINATIONAL SCATTERING P. A. Apanasevich and D. N. Ordabayev p 1–15 refs (See N68-22130 12-24)
2. SYSTEM OF SYNCHRONIZATION OF STARTING FOR LASER WITH PULSE QUALITY V. A. Pilipovich and Yu. F. Morgun p 16–18 (See N68-22131 12-16)

N68-22217 California Univ., Los Angeles.

EXPERIMENTAL INVESTIGATION OF THE LAMBDA TRANSITION OF LIQUID HELIUM USING ACOUSTIC TECHNIQUES

Martin Bruce Barmatz (Ph.D. Thesis) 1966 114 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-4494

The velocity and attenuation of first sound have been measured to within microdegrees of the lambda transition of liquid helium. A technique was developed to continuously monitor the velocity of sound and attenuation simultaneously as the resonator drifted through the transition. With the high Q modes of the resonator, relative sound velocity measurements of one part in 10^5 could be obtained. Above the transition the velocity of sound had the temperature dependence predicted by the Pippard theory out to 5 millidegrees from the lambda point. The data of this experiment indicate that the results above and below the transition approach a common value at the lambda point. The minimum of the sound velocity at the lambda point was found to be finite and equal to 217.05 m/s. Using the convective properties of the resonator, the position of the density maximum was found to be approximately 6.2 millidgrees above the lambda point. Dissert. Abstr.

N68-22225*# Illinois Univ., Urbana. Electrical Engineering Research Lab.

RAY STATISTICS IN A RANDOM MEDIUM WITH STRATIFIED BACKGROUND. DIFFUSION OF RAYS IN RANDOM MEDIA

C. H. Liu and K. C. Yeh Feb. 1968 45 p refs
(Grants NsG-24; NSF GA-1249)
(NASA-CR-94306; TR-33) CFSTI: HC $3.00/MF $0.65 CSCL 20F

The problem of propagation of light rays in a stratified medium in the presence of random irregularities is investigated. Starting from the ray equations, a systematic asymptotic expansion is used to find the ray trajectory. Statistical quantitites of the ray such as the mean square fluctuations of the transverse displacement and the ray direction are then computed. The results are compared with those for a homogeneous background. The propagation of rays in a random medium is also investigated. For ray path larger than the correlation distance the probability density of finding the ray satisfies a Fokker–Planck equation. It is shown that the coefficient of the equation is related to the correlation function of the logarithm of the refractive index. The Fokker–Planck equation is treated for three initial conditions. Technique for handling the general initial condition has been also indicated. Author

N68-22242*# Informatics, Inc., Los Angeles, Calif.

FORTRAN OPTICAL LENS DESIGN PROGRAM. VOLUME 1: MATHEMATICAL SPECIFICATIONS

Paul J. Firnett and Leslie A. Wilson 15 Aug. 1967 152 p refs
Prepared for JPL
(Contracts NAS7-100; JPL-951495)
(NASA-CR-94323; TR-67-700-10-2, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 20F

Geometry, ray specification and tracing, system characteristics, computation and display of spot diagrams, sensitivity analysis, and cross sectional plotting are described for FOLDP, FORTRAN Optical Lens Design Program. A digital computer program written in 7094 FORTRAN IV source language, FOLDP uses the principles of geometric optics to automatically design optical systems and can handle systems containing up to 100 surfaces, seven objects points, six colors, and 200 rays. M.W.R.

N68-22244 Nebraska Univ., Lincoln.

DYNAMIC SYSTEMS WITH INVERSE QUADRATIC RESTORING FORCES

William Charles Kinsel (Ph.D. Thesis) 1966 118 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-4068

A class of nonlinear dynamical systems, with inverse quadratic restoring forces, has been investigated. The general behavior of two specific systems was established and approximate solutions to their differential equations of motion were obtained. The first system, with an asymmetrical restoring force, behaved remarkably like a linear system except that its oscillations were asymmetrical. The Collocated Exponential Series Method (CESM) was used for the theoretical analysis. Certain theoretical equations were solved numerically on the IBM 704 Digital Computer. Extensive forced vibration data, damped and undamped, were generated on the Donner 3400 Analog Computer. The second system, with a symmetrical restoring force, behaved qualitatively like a Duffing hard spring system. The approximate Ritz–Galerkin Method of theoretical analysis correlated better with the analog computer results than did the Collocated Exponential Series Method. Dissert. Abstr.

N68-22248# University Coll., London (England).

DYNAMICS OF THE SOLAR WIND

A. A. Faus Paris ESRO Dec. 1966 44 p refs
(ESRO-SN-5) CFSTI: HC $3.00/MF $0.65

A discussion of the different coronal models is presented. The boundary condition of zero pressure at infinity discards Chapman's static model; both Parker's solar wind (supersonic) and Chamberlain's solar breeze (subsonic) models are consistent with this condition. It is found that a supersonic solar wind based upon the hydrodynamic equations is consistent with coronal observations. Typical values of this solar wind beyond 1 AU are computed. The study of a shock wave formation gives a distance of occurrence at 15–500 AU corresponding to 3–0.1 gamma interstellar magnetic field, respectively. It is shown that such a shock wave implies a hot ($3\times10^{\text{[illegible]}}$ K) tenuous gas region surrounding the solar system. It is suggested that the solar wind terminates by means of a non-adiabatic free expansion that occurs at 1–3 AU where gas pressure and density are comparable with the interstellar estimates. The suggested transition zone after comet tail observations occurs at the same distance. Author (ESRO)

N68-22268 Princeton Univ., N. J.

OPTICAL PUMPING IN ATOMIC HYDROGEN

Thomas James McIlrath (Ph.D. Thesis) 1966 302 p
Available from Univ. Microfilms: HC $13.75/MF $3.90 Order No. 67-5737

This thesis involved attempts to optically pump atomic hydrogen. Detailed calculations for optical pumping in atomic hydrogen and detailed signal estimates were made. A detailed study of atomic hydrogen and Lyman-alpha radiation was made with the aim of optically pumping atomic hydrogen. A high intensity Lyman-alpha electrodeless discharge lamp was constructed. Studies were made of photodetectors for Lyman-alpha using stainless steel photo-cathodes. The absorption of Lyman-alpha by atomic hydrogen was analyzed. The properties of Lyman-alpha reflected from various absorbing surfaces were established. Both reflectivities and phase shifts were measured. Circularly polarized Lyman-alpha was obtained with high intensities by successive reflections from Al_2O_3 and Al mirrors. Efforts to observe optical alignment and optical orientation were made. Theoretical treatments of optical orientation and alignment are given. Dissert. Abstr.

N68-22283 Lockheed Missiles and Space Co., Palo Alto, Calif.

ON NONSTATIONARY DIFFUSION OF RADIATION IN AN INHOMOGENEOUS MEDIUM

I. N. Minin [1968] 4 p refs Transl. into ENGLISH from Astrofiz. (USSR), v. 3, no. 3, 1967 p 345–350

A method is proposed for the solution of problems in the nonstationary diffusion of radiation in an inhomogeneous stationary medium. An example of application of the method to the problem of diffuse light reflection is given. Author

N68-22380 Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON ASYMPTOTIC FORMULAS FOR THE X AND Y FUNCTIONS IN THE THEORY OF MULTIPLE RADIATION SCATTERING IN LINES

A. I. Nagirner 1967 15 p refs Transl. into ENGLISH from Astrofizika (USSR), v. 3, no. 3, Aug. 1967 p 292–310

Scattering of resonant radiation in a plane layer of large optical thickness is studied. It is considered that pure scattering occurs, with complete frequency redistribution. The Doppler contour of the absorption coefficient and the contour which decreases at the line wing in proportion to some power of the frequency are considered. Asymptotic formulas, encompassing all values of the argument are obtained for the functions in terms of which the outgoing radiation intensities are expressed in many cases. As illustrations of the application of the obtained asymptotics, some radiation line contours are constructed and asympototic expressions are also found for the mean number of scatterings in a layer. Author

N68-22385# Sandia Corp., Livermore, Calif.

FILAMENT WINDING A SURFACE OF REVOLUTION

S. P. Gold Feb. 1966 38 p refs
(Contract AT(29-1)-789)
(SCL-DR-65-102) CFSTI: HC $3.00/MF $0.65

Various lemmas and proofs that are useful for filament winding a surface of revolution are presented. It is proved that the family of geodesics on an approximating surface converges to the family of geodesics on the actual surface. In addition, the amount that a filament path can deviate from a geodesic and not slip from the surface is calculated. Author (NSA)

N68-22392# Syracuse Univ., N. Y. Dept. of Physics.

INDEFINITE METRIC AND NONLOCAL FIELD THEORIES

E. C. G. Sudarshan Oct. 1967 39 p refs Presented at 14th Solvay Conf., Brussels, 2–7 Oct. 1967
(Contract AT(30-1)-3399)
(SU-1206-131; NYO-3399-131) CFSTI: HC $3.00/MF $0.65

A meaningful relativistic quantum field theory with local interactions in an indefinite metric space is developed. The theory yields transition amplitudes which have some superficial resemblance to those obtained by regularization but they are essentially distinct. The mathematical structure of the theory is different from that of the field-theoretic version of regularization. The question of identification of the physical probability amplitudes is considered and solved. NSA

N68-22395 Lockheed Missiles and Space Co., Palo Alto, Calif.
ON TAKING ACCOUNT OF SCATTERING IN RADIANT HEAT EXCHANGE PROCESSES
Iu. A. Popov [1968] 6 p refs Transl. into ENGLISH from Inzh. Fiz. Zh., Akad. Nauk Belorussk. SSR (Minsk), v. 13, no. 4, 1967 p 496–501

The problem of isotropic radiation passing through a dissipating layer with a spherical scattering index and the problem of radiation of a constant temperature layer are solved by the Bubnov–Galerkin method. Author

N68-22416*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
SUM RULES FOR VARIATIONAL WAVE FUNCTIONS
Saul T. Epstein 15 Mar. 1968 7 p refs
(Grant NsG-275-62)
(NASA-CR-94597; WIS-TCI-290) CFSTI: HC $3.00/MF $0.65 CSCL 20J

Conditions are given under which a variationally determined frequency dependent polarizability will satisfy the oscillator strength sum rule. Author

N68-22477 Joint Publications Research Service, Washington, D. C.
POSSIBILITY OF EXPERIMENTAL STUDY OF THE PROPERTIES OF TIME [PULKOVO, O VOZMOZHNOSTI EKSPERIMENTAL'NOGO ISSLEDOVANIYA SVOYSTV VREMENI]
N. A. Kozyrev 2 May 1968 28 p refs Transl. into ENGLISH from Russian
(JPRS-45238)

The theoretical concepts relating to the properties of time are discussed. Consideration is given to the manner in which the concept of the directivity of time or its pattern can be introduced in the mechanics of elementary processes. The problem is discussed in relation to the classical mechanics of a point or a system of material points. It is stated that causality is linked in the closest way with the properties of time, specifically with the difference in the future and the past. An hypothesis is put forward that: (1) time possesses a quality, creating a difference in causes from effects, which can be evoked by the directivity of pattern; (2) causes and results are always separated by space; (3) causes and results are separated in time. The experiments conducted in order to verify these theoretical concepts are described, and an assessment is made of the findings. Based on the concepts and experimental data, the general inferences were made that the causal states, derived from the basic axioms, of the effect concerning the properties of a time pattern are confirmed by the tests, and that the tests proved the existence of the effects through time of one material system upon another. B.S.D.

N68-22478 Lockheed Missiles and Space Co., Palo Alto, Calif.
ON SOME FUNCTIONS IN THE THEORY OF LIGHT SCATTERING
V. V. Sobolev 6 Sep. 1967 9 p refs Transl. into ENGLISH from Astrofiz. (USSR), v. 3, no. 4, Nov. 1967 p 433–445

It is proposed to use equations containing the quantity λ as independent variable to solve various problems of the theory of multiple light scattering. However, it is possible to try to form equations for the radiation intensity in which the quantity λ is also an independent variable. Such equations, which include derivatives and integrals with respect to λ will describe the change in the radiation field in the medium for a change in λ from one value to another. The particular problem of light scattering in a semi-infinite medium will be solved here by using an equation in which the derivative with respect to λ enters. A number of formulas are hence obtained for quantities characterizing the radiation field. However, our purpose is not only to obtain these formulas, but also to elucidate the new method of obtaining them. Author

N68-22585 Lockheed Missiles and Space Co., Palo Alto, Calif.
INVESTIGATION OF THE SOLUTION OF THE NONSTATIONARY PROBLEM OF PLANE WAVE DIFFRACTION BY AN IMPEDANCE WEDGE
A. F. Filippov 12 May 1966 12 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 7, no. 4, 1967 p 825–835

A theory of generalized functions is presented for solving plane wave diffraction problems by taking into account the behavior of the solution near the edge of an impedance wedge. Formulas are given for reflected waves in the general case, and it is shown that the solution of the diffraction problem equals the sum of the incident and reflected waves. E.J.S.

N68-22600# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
METHOD OF QUANTITATIVE THERMOLUMINESCENCE
C. R. Watson 4 Jan. 1968 3 p Presented at the Conf. of Interdisciplinary Discussion of Solid State Dosimetry, Seattle
(Contract AT(45-1)-1830)
(BNWL-SA-1575; CONF-671121-2) CFSTI: HC $3.00/MF $0.65

A method is described which allows simultaneous recording of the thermoluminescent glow curve and the integral under any specific peak. The mechanical integrator employed, attached to a strip chart recorder, is inexpensive and reliable. Author (NSA)

N68-22709# Oak Ridge National Lab., Tenn.
DETERMINATION OF OPTICAL CONSTANTS OF PALLADIUM BY ELLIPSOMETRY
Margaret S. Riedinger and L. C. Emerson Feb. 1968 45 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2114) CFSTI: HC $3.00/MF $0.65

Techniques for making ellipsometric measurements in the ultra-high vacuum region were developed. The techniques were used to determine the optical constants of Pd in the visible and infrared regions. Results are compared with measurements of other investigators using photometric and interference methods. NSA

N68-22845*# North Carolina State Coll., Raleigh.
NONLINEAR EFFECTS IN OPTICAL DATA PROCESSING Final Progress Report
Frederick J. Tischer and J. P. Moffatt 15 Mar. 1968 85 p refs
(Grant NGR-34-002-038)
(NASA-CR-94405) CFSTI: HC $3.00/MF $0.65 CSCL 20F

Methods for analyzing the effects of nonlinearities in optical data processing are considered. A method in which nonlinear characteristics are represented by Tchebyscheff's expansions is developed. It is characterized by improved accuracy and simplicity of application. Procedures for the determination of the coefficients and a computer program are described. The procedures and the computer program were used for analysis of spectroscopic photographic plates. Author

N68-22916*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

ANNULAR APERTURE DIFFRACTED ENERGY DISTRIBUTION FOR AN EXTENDED SOURCE

I. L. Goldberg and A. W. McCulloch Apr. 1968 33 p refs
(NASA-TM-X-63186; X-622-68-132) CFSTI: HC $3.00/MF $0.65 CSCL 20F

The annular aperture diffracted energy within a circular area in the image plane for an extended circular incoherent source is obtained by adding the diffraction contributions from all the elemental areas making up the source surface. Each of the source elemental areas is treated as a distant point source so that the formula for annular aperture Fraunhofer diffraction intensity may be used. The necessary integration for both the point and extended source cases were carried out numerically by means of the IBM 360 computer and the results are listed for source angular sizes up to five times the angular size of the Airy disk. Assuming that the angular diameter of the circular area in the image plane containing 83.8% of the diffracted energy from the extended source is the effective angular resolution of a scanning optical instrument it is shown that for a central obstruction diameter 40% of the aperture diameter the effective angular resolution is degraded by less than 30% when the instantaneous field of view is increased from 1 to 2 (angular) Airy diameters. Author

N68-22962 California Univ., Los Angeles.

NEW INFRASONIC MEASUREMENT TECHNIQUES AND OBSERVATIONS OF ROCKET ENGINE NOISE

Uri Fehr (Ph.D. Thesis) 1966 298 p
Available from Univ. Microfilms: HC $13.50/MF $3.85 Order No. 67-4487

Upper atmospheric artificial sources for infrasound generated by ignition of the upper stages of space vehicles and missiles are described, and certain effects of the atmosphere on the signals propagating to the ground were established. The two types of rocket motors observed were the Agena, which ignited at 140 km altitude and almost 700 km slant range from the detector array, and the Castor and Antares, second and third stages of the Scout vehicle. The approach employed here was to experimentally monitor the rocket motors from the initial phase of lift-off from the launching pad through their flight in the atmospheric and ionospheric regions. The first-stage disturbance enabled the study of rocket motors, both the liquid and solid propellant engines, as infrasonic sources, and a full description in the frequency range from 20 to 0.05 cps is given. Dissert. Abstr.

N68-23031 Lockheed Missiles and Space Co., Palo Alto, Calif.

ABSORPTION METHOD OF DETERMINING RADIATION SPECTRA

V. P. Kozlov and A. A. Iakolev [1967] 8 p refs Transl. into ENGLISH from Zh. Prikl. Spektr. (Moscow), v. 7, no. 5, 1967 p 684–690

Radiation of complex spectra composition is considered that is passing through a layer of selectively absorbing material, and the integrated light flux at the exit from the layer is expressed in accordance with the Boguer law. Influence of interference on the accuracy of determining spectral distribution is accounted for, and the generalized resolving power of an absorption spectrometer and a prism monochromator were compared numerically. The solution for the distribution of radiation spectra is found from the minimum condition of the mean-square deviation of an ideal output signal from the true signal, with an ideal output signal considered to be one formed from a spectrum of Gaussian form in the absence of noise. These investigations showed that an absorption spectrometer could be used to find the spectral composition of radiation. Weak light fluxes can be studied since the resolution is not saturated for very large values as compared to other methods. M.W.R.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N68-21853 California Univ., San Diego.

MODES OF MOTION OF ODD-MASS SPHERICAL NUCLEI

Arnold Ira Sherwood (Ph.D. Thesis) 1966 146 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-2742

The low-lying states of an odd-mass spherical nucleus are considered as arising from the coupling of an independent particle mode to an even vibrating core. The method of treatment proceeds from a consideration of the equation of motion of the independent particle. This yields a set of couple linearized equations for the amplitudes of excitation of the states of the odd-mass nucleus with respect to those of the even core, which is expressed in matrix form. In order to insure that this matrix is hermitian (in contrast to the second random phase approximation), the problem is formulated so that only amplitudes of single excitations appear. This is accomplished by employing an expansion in terms of a complete set of states of the even core. Dissert. Abstr.

N68-21857 California Inst. of Tech., Pasadena.

AN INVESTIGATION OF THE COMPOUND NUCLEI ^{7}Li AND ^{7}Be

Robert John Spiger (Ph.D. Thesis) 1967 329 p
Available from Univ. Microfilms: HC $14.85/MF $4.25 Order No. 67-5069

The differential elastic scattering cross section has been measured for the scattering of ^{3}He from ^{4}He and the scattering of ^{4}He from tritium. Incident particle energies of 5 to 18 MeV and 4 to 18 MeV, respectively, were used. Gas targets and solid state silicon detectors were employed. Data were also obtained for the reactions $^4He(^3He,p)^6Li$, $^4He(^3He,p^1)^6Li^*$, $^3H(\alpha,n)^6Li$ and $^3H(\alpha,n^1)^6Li^*$. Levels are seen at 4.65, 6.64, 7.47 and 9.7 MeV in ^{7}Li and at 4.57, 6.73, 7.21 and 9.3 MeV in ^{7}Be. A phase shift analysis suggests assignments of $7^-/2$ and $5^-/2$ for the two lower levels in ^{7}Li, confirms the $5^-/2$ assignment of the 7.47 level and suggests a $7^-/2$ assignment for the new level at 9.7 MeV. Similarly in ^{7}Be, the assignment of $7^-/2$ and $5^-/2$ for the lower two levels is reconfirmed and an assignment of $7^-/2$ is suggested for the new level at 9.3 MeV. The reduced widths for α and nucleon emission were determined. Dissert. Abstr.

N68-21918 Illinois Univ., Urbana.

THE TOTAL MUON POLARIZATION IN $K_{\mu 3}^{\circ}$ DEG MESON DECAY

Robert Jay Abrams (Ph.D. Theory) 1966 64 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-6539

A spark chamber experiment was performed at the Argonne National Laboratory Zero Gradient Synchrotron to study the polarization of the muon in the decay $K_L^{\circ} \rightarrow \pi^- \mu^+ \nu$. The results of the test of time reversal invariance and the value obtained for the form factor ratio will be presented. K_L° mesons, from the 31° neutral beam, decayed in vacuum in a magnetic field. The momenta of the π^- and the μ^+ particles were measured by means of foil spark chambers inside the magnet. A kinematic reconstruction of the K_L° decay was made for each event. In the 1602 events selected, the muon passed through a thick absorber, came to rest in a set of aluminum range spark chambers, and decayed $(\mu^+ \rightarrow e^+ + \nu + \bar{\nu})$. The muon polarization was determined from a study of the angular distribution of the decay positrons. Dissert. Abstr.

N68-21939# Aerospace Research Labs., Wright-Patterson AFB, Ohio.

THE HARMONIC AND NULL DESCRIPTIONS OF GRAVITATIONAL RADIATION

Richard A. Isaacson and Jeffrey Winicour 1968 23 p refs
(AD-666049)

The problem of an axially symmetric space-time containing gravitational waves in the usual Bondi null coordinate system is considered. This Bondi frame is then related to asymptotically harmonic coordinates by means of a characteristic initial value problem. The resultant functional relationship between the null and asymptotically harmonic frames is used to transform Bondis radiative metric into its equivalent asymptotically harmonic form. This is then compared to the radiative solution which Fock has calculated directly using harmonic coordinates. In agreement with Fock, one finds that the harmonic form of the radiation metric contains logarithmic terms. The treatment clearly shows that these logarithmic metric components do not result from the well known logarithmic terms in the harmonic coordinate description of the light cones for Schwarzschild-like geometries. The principal result of this paper is that they arise from higher order radiative corrections. TAB

N68-21949*# General Electric Co., Philadelphia, Pa.

THE ROLE OF ENERGY IN DEFORMATION

I. J. Gruntfest Washington Apr. 1968 31 p refs
(Contract NASw-1190)
(NASA-CR-1039) CFSTI: HC$3.00/MF$0.65 CSCL 20L

This report is a review of exploratory analytical studies of the influence of energy conservation on the mechanical behavior of a variety of materials in diverse test situations. The results are presented and discussed so to display their physical implications rather than the details of their development. The work is generally complementary to the existing body of theory relating to mechanical behavior. However, consideration of the necessary coupling between the thermal and mechanical fields in deforming materials does suggest some new approaches to the problems of fracture in solids and flow stability in fluids. Some insights into the role of microstructure in determining the behavior of solids are also suggested. The methods, some of which involve the use of electric analogs of the mechanical system, show how necking, yield and plastic flow may arise. In addition, scale effects are introduced which are likely to be of interest in geophysical phenomena. Author

N68-21958 California Inst. of Tech., Pasadena.

UPPER LIMITS ON NEUTRAL ASSOCIATED PHOTOPRODUCTION CROSS SECTIONS

Donald Gerald Coyne (Ph.D. Thesis) 1967 136 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-4775

A search for events of the type $\gamma+n\rightarrow K^0+\Lambda^0$ or $\gamma+n\rightarrow K^0+\Sigma^0$ has been made. Photon energies up to 1530 MeV were available. The technique used was to observe the region near the interaction point using a heavy liquid bubble chamber, with the liquid surrounding a central tube containing deuterium gas. About 14,000 pictures were multiply scanned and analyzed by techniques developed especially for these reactions. The most probable conclusion is that no events of the above types were seen. The meaning of this result in terms of limits on the average cross sections for those interactions is given, and the significance of the result with respect to previously published theories and experiments is discussed. Dissert. Abstr.

N68-21967 Iowa State Univ. of Science and Technology, Ames.

DOUBLE PION PRODUCTION WITHOUT ANNIHILATION IN ANTIPROTON-PROTON INTERACTIONS AT 2.7 BEV/C

Henry Bert Crawley (Ph.D. Thesis) 1966 64 p
Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-5576

A study was made of the reaction $\bar{p}p\rightarrow\bar{p}p\pi^+\pi^-$, at an incident antiproton momentum of 2.7 BeV/c. A comparison of the data with the predictions of the form-factor and absorption one-pion-exchange models was made. For the form-factor model only the contribution from the "double-isobar" diagram was included. For the absorption model predictions were compared with the data. It is found that both models account for the peripherality of the $\bar{N}^*$ production and for the effective mass distribution, but that neither model is successful in explaining the decay angular distributions. Dissert. Abstr.

N68-21990# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.

MASS RELATIONS FOR 1^- AND 1^+ NONETS BASED ON WEINBERGS SUM RULES

Ken Kawarabayashi and Shinsaku Kitakado Jan. 1968 10 p refs
(RIFP-67) CFSTI: HC$3.00/MF$0.65

A mass relation among isospin singlets of 1^+ and 1^- nonets is obtained by making use of Weinberg's sum rules based on asymptotic $U(3)\otimes U(3)$. Possible existence of the ninth member of 1^+-nonet is suggested and its mass is predicted from this relation. Author

N68-21997 Connecticut Univ., Storrs.

MEASUREMENTS OF RESONANT ELECTRON CAPTURE IN CLOSE P ON H COLLISIONS

Herbert Frederick Helbig (Ph.D. Thesis) 1966 57 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-4557

Differential measurements of the electron capture probability P_0 are made for protons scattered from atomic hydrogen targets. The incident proton energy ranges from 150 keV down to 0.130 keV and the scattering angle is varied between 0.2° and 6.0°. Seven sharply-resonant peaks of P_0 are found, their location depending on both energy and angle. For example, when the scattering angle is held at 6° the peaks are found at 21, 3.9, 1.7, 0.90, 0.54, and 0.36, and 0.19 keV, and when the energy is fixed at 0.250 keV peaks are found at 0.7°, 1.4°, 2.6°, and 4.5°. In some cases the equivalent collision with deuterium, D^+-D, is used to augment the range of the measurements. These data extend those reported by Lockwood and Everhart (1962) who studied this same phenomenon in H^+-H collisions over a smaller range in energy and at fixed 3° scattering angle. Relative differential cross section data are presented also which show a change in slope with the onset of rainbow-angle scattering conditions. Dissert. Abstr.

N68-22003 New York Univ., N. Y.

UNITARY IMPULSE APPROXIMATION WITH APPLICATION TO PION-NUCLEON SCATTERING

Robert Warren Finkel (Ph.D. Thesis) 1966 87 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-6015

A generalization of the impulse approximation, which automatically satisfies unitarity conditions in two- and three-body channels, is determined from linear integral equations of the Heitler form, with the K matrix replaced by the ordinary impulse approximation. In a model three-body potential problem, the unitary impulse approximation is found to be a significant improvement over the ordinary impulse approximation when multiple scattering effects are important. The method is applied to pion-nucleon collisions in the second and third resonance regions. The input to this calculation is an impulse approximation to pion-nucleon scattering with a rho resonance formula for the subordinate pion-pion interaction. All the complications of spin and isospin are retained and no adjustable parameters are introduced. Resonant behavior is found in the 600 MeV and 900 MeV neighborhoods. Dissert. Abstr.

N68-22004 North Carolina State Coll., Raleigh.

NEUTRON SLOWING-DOWN IN FINITE MODERATOR MEDIA FROM A FAST NEUTRON BURST

Bobby Eugene Leonard (Ph.D. Thesis) 1966 124 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-5661

Slowing-down of neutrons from a fast neutron "delta function" burst was examined. Constant and (1/v) variation of neutron absorption and scattering was considered as well as the diffusion approximation for neutron leakage from the systems. For these models, exact solutions are provided for constant and (1/v) absorption with constant scattering in finite hydrogen systems. A solution referred to as the "Energy Interval Method" was developed for non-hydrogenous moderators. The effect of a pulse of finite duration is also demonstrated. It has been shown that the same information may be obtained by a source of long duration as with a "delta" function source. The important question as to whether slowing-down measurements appear feasible at very short times after the burst is explored. Dissert. Abstr.

N68-22007 Indiana Univ., Bloomington.

BETA–GAMMA DIRECTIONAL CORRELATION MEASUREMENTS AND ANALYSIS FOR SOME ANOMALOUS BETA TRANSITIONS

Bruce Keith Cantrell (Ph.D. Thesis) 1966 112 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-3654

The energy dependence of the beta-gamma directional correlation was measured for the 1.5 MeV. anomalous allowed decay of Co^{56} and the 2.3 MeV. first forbidden transition of Sb^{124}. The measurement was done using a shaped field magnetic spectrometer. For Co^{56}, over an energy range of 0.5 to 1.4 MeV., ϵ varied from 0.006 ± 0.007 to 0.039 ± 0.016. To contrast this with a zero directional correlation measurement using the same apparatus, a recent measurement of the 0.49 MeV. transition in Co^{58} is also reported as $\epsilon = 0.025 \pm 0.0046$. The measurement for Sb^{124} over the energy range of 1.0 to 2.1 MeV. gave a directional correlation of $\epsilon = (-0.22 \pm .02$ to $-0.40 \pm 0.01)$. To determine empirical values for the nuclear matrix elements associated with these decays, a general analysis scheme using a chi-square minimization was developed. Generally, the analysis compares the experimental data with the theoretically derived values of the observable for the shape, beta-gamma directional correlation and the beta-(circularly polarized) gamma angular correlation. Dissert. Abstr.

N68-22008 Stanford Univ., Calif.

ELECTROPRODUCTION OF π-MESONS FROM HYDROGEN

Stephen Philip Berezin (Ph.D. Thesis) 1966 167 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-4318

The electroproduction of π-mesons ($e^- p \rightarrow e^- n \pi^+$) and the electroproduction of π-meson pairs ($e^- p \rightarrow e^- p \pi^+ \pi^-$) have been investigated utilizing the Stanford Mark III electron linear accelerator. The experiment was performed at two values of the initial electron energy (700 and 900 MeV) and three values of the π-meson production angle (40°, 60°, 90°). The π-mesons resulting from the interaction were momentum-analyzed by the 72-in. radius magnetic spectrometer and were detected by a combination of a 2-counter, plastic scintillation telescope and 16 in. f NaI(Tl) arranged into 4 optically separated counters. Cross sections for the single-π^+-meson production are analyzed in terms of the virtual photon spectrum associated with the scattered electron and are compared to the latest photoproduction data. Cross sections for the π-meson pair production reaction can be analyzed in terms of its available phase space. It is shown that the N^{*2+} isobar dominates the threshold behavior for this case. Dissert. Abstr.

N68-22020# Polish Academy of Sciences, Warsaw. Institute of Nuclear Physics.

SHADOW ELASTIC SCATTERING IN THE MULTI-REGGE-EXCHANGE MODEL [CIENIOWE RAZPRASZANIE ELASTYCZNE W MODELU WIELOKROTNEJ WYMIANY BIEGUNOW REGGE]

L. Michejda, J. Turnau (Jagellonian Univ., Cracow), and A. Bialas (Jagellonian Univ., Cracow) 1968 12 p refs
(Rept.-880/6/PH) CFSTI: $3.00

Shadow elastic scattering in the multi-Regge-exchange model of Chan et al. is estimated. The necessity of introducing the momentum-transfer-dependent phases is pointed out. Author

N68-22040 Stanford Univ., Calif.

THE STRUCTURE OF CERTAIN NUCLEI AS DETERMINED FROM ELECTRON SCATTERING

Benjamin Franklin Gibson, V (Ph.D. Thesis) 1966 91 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-4351

Elastic electron scattering provides the best experimental method of examining the electromagnetic structure of the ground state of the nucleus. Part I considers the electric and magnetic moment form factors of H^3 and He^3 as determined from elastic electron scattering data and the nonrelativistic wave function description of the three-body system necessary to account for their shape. Part II deals with the charge structure of the calcium isotopes as evidenced in the dependence of the elastic electron scattering cross sections upon the charge distribution. Dissert. Abstr.

N68-22042 Stanford Univ., Calif.

STUDY OF He^3 RADIATIVE CAPTURE REACTIONS

Nuggehalli Gujjegowda Puttaswamy (Ph.D. Thesis) 1966 131 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-4419

Four He^3 radiative capture reactions have been studied by using the He^3 beam from a 3-MV Van de Graaff accelerator. The gamma rays produced by He^3 bombardment of C^{13}, C^{12}, B^{11}, B^{10} are detected by a NaI(Tl) crystal surrounded by a plastic anticoincidence shield. Pulse-pileup rejection is accomplished by the use of a tunnel-diode discriminator. The differential cross section for He^3-capture gamma rays are found to be typically 0.1 μb/sr. Dissert. Abstr.

N68-22050 Florida Univ., Gainesville.

A CONFIGURATION INTERACTION STUDY OF THE BERYLLIUM ATOM

Carlos Federico Bunge (Ph.D. Thesis) 1966 75 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-3462

A configuration interaction (CI) study of the Be atom is made, with particular emphasis on the total energy and the quality of the wave function. The ground state energy $E = -14.662132$ m.a.u., obtained from a 155 CI expansion, compares favorably with all previous results in which a rigorous method was employed. The energy effects introduced by quadruply excited configurations are found to be similar to the ones already reported. This is not so for the singly and triply excited configurations where the energy contributions obtained are considerably larger than expected; such a result will affect, in part, previous calculations in which estimates of the Be correlation energy were made by using the many electron theory of atoms and molecules. The radial density distribution of electronic charge is calculated from the 155 CI expansion, and the result is compared with the one given by a Hartree–Fock wave function. Dissert. Abstr.

N68-22068 Stanford Univ., Calif.

NEUTRON PROTON ELASTIC SCATTERING FROM 1 TO 6 GEV

Michael Norman Kreisler (Ph.D. Thesis) 1966 123 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-4388

The first measurements of neutron–proton elastic scattering from 1 to 6.3 GeV were made using spark chambers. A well-collimated neutron beam produced by the external proton beam of the Bevatron at the Lawrence Radiation Laboratory interacted in a liquid hydrogen target. The recoil proton momentum and angle were measured with a bending magnet and spark chambers, and the scattered neutron angle was measured with an array of steel plate spark chambers. The results based on 6219 elastic events are presented as differential cross sections versus the four momentum transfer squared, $|t|$, in 1 GeV energy intervals. Shrinkage of the diffraction peak is observed and found to be similar to proton–proton scattering. No statistically significant secondary peak is observed. The large angle measurements indicate symmetry around 90° in the center-of-mass system with the minimum in the cross sections at or just beyond 90°. The data is consistent with an exponential decrease of the large angle cross sections with the total center-of-mass energy. Dissert. Abstr.

N68-22069 Stanford Univ., Calif.

INELASTIC ELECTRON SCATTERING FROM HYDROGEN

Harvey Lee Lynch (Ph.D. Thesis) 1966 127 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-4398

A large body of data on inelastic electron scattering from hydrogen is presented in two groups. One group consists of data at fixed momentum transfer, q, and fixed secondary energy with the energy loss as a variable. These data are taken for q^2 ranging from 0.1 to 0.6 in steps of 0.1 $(\mathrm{BeV}/c)^2$ and secondary energies of 100, 150, 200, and 400 MeV; they concentrate on production of the first pion-nucleon resonance, although some data extending out to the second resonance are also presented. The other group of data is taken at constant momentum transfer and constant equivalent photon energy, K: q^2 ranges from 0.1 to 0.6 in steps of 0.1 $(\mathrm{BeV}/c)^2$ and K is 340 (first resonance) and 500 MeV. These data are designed to separate the contribution of transversely and longitudinally polarized photons to the inelastic cross section. The transverse part, σ_t, is found to be dominant, but the longitudinal part, σ_s, is not zero at resonance but zero above resonance. Dissert. Abstr.

N68-22070 California Univ., Berkeley.

APPROXIMATIONS IN THE THEORY OF REARRANGEMENT COLLISIONS AND APPLICATIONS TO A TRACTABLE MODEL OF CHARGE EXCHANGE SCATTERING

James Quong (Ph.D. Thesis) 1966 91 p
Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-5145

The approximation ideas and methods and the historic difficulties involved with the calculation of ion atom rearrangement scattering are examined and redeveloped. Five approximation schemes are selected to be tested. The transition probability for symmetric resonant charge exchange is calculated by these methods for a model one-dimensional scattering system whose exact solution, serving as the basis for comparison, is also attainable by numerical techniques. The impact parameter ideas concerning the uncoupling of the internal and external dynamics are built into the model. None of the high energy theories are found to be adequate beyond the upper intermediate range; this suggests at least that the convergence of perturbation expansions is slow. The two improved first order schemes, for which the effects of non-orthogonality have been eliminated, are adequate only at upper intermediate energies. An exchange mechanism is found to be operative for all energies up through the intermediate range. Asymmetric resonant and nonresonant exchange are examined briefly at low and intermediate energies. Dissert. Abstr.

N68-22076 Northwestern Univ., Evanston, Ill.

BARYON MASS SPECTRA IN A DYNAMICAL S-WAVE SU(6) MODEL

Juergen Hans Garlef Koerner (Ph.D. Thesis) 1966 83 p
Available from Univ. Microfilms: HC $4.40/MF $3.00 Order No. 67-4240

Some results on the mass spectra of the $56^{(+)}$ and the proposed $70^{(-)}$ and $20^{(+)}$ SU(6) baryon multiplets are presented as calculated from a simple S-wave SU(6) invariant dynamical model involving first order mass deviations. We take the meson masses from experiment and obtain reasonable agreement with the experimentally known baryon masses. The masses of the missing members of the multiplets are estimated. The mass spectrum of the 70 is discussed in detail. A two parameter calculation using the experimental 56 and 35 mass spectra yields a mass spectrum in qualitative agreement with a recent non-dynamical calculation, in which 6 parameters have been used. The three mixing angles occurring in the 70 are estimated from the model and found to be small. On this basis some new approximate mass rules are given. We derive explicit representations for the reduced matrix elements of the strong interaction mass operator for the SU(6) 35, 56, 70 and 20 representations. Dissert. Abstr.

N68-22102 Virginia Univ., Charlottesville.

RADIATIVE PION ABSORPTION AND THE STRUCTURE OF LIGHT NUCLEI

David Kyle Anderson (Ph.D. Thesis) 1966 99 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-3744

A theoretical investigation of radiative pion absorption by certain light nuclei is carried out. The impulse approximation is used to derive a transition operator for this reaction from the inverse process of pion photoproduction. It is shown that spin and isospin dependent collective vibrations play a dominant role in the process and it is concluded that radiative absorption can be used to study such excitations. The probability of radiative absorption is estimated and is in agreement with experiment. Dissert. Abstr.

N68-22112# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research

LAMBDA–NUCLEON SCATTERING

A. Deloff 1967 29 p refs Submitted for publication
(Rept.-848/7/PL) CFSTI: $3.00

A one-boson-exchange (OBE) model of baryon–baryon interaction is developed. The forces are assumed to be generated by the exchange of 0^-, 1^- octets, and a tentatively assumed 0^+ octet simulating two boson exchange effects. To obtain the relevant coupling constants and masses of 0^+ particles the Hamada–Johnston N–N potential is fitted by OBE potential. This, together with SU(3) symmetry assumed for the couplings, determines completely the Λ–N potential. The resulting potential has appeared too strong but slight adjustment of the coupling constant of the $0^+ I=0$ particle gave a very good agreement with the experimental data on Λ–N scattering. We find rather strong tensor force operating in the Λ–N system and this may explain the existing discrepancy between the hypernuclear and fitted estimates of the strength of the Λ–N forces. Author

N68-22123 California Univ., Berkeley.

MULTI-PION FINAL STATES FROM NEGATIVE PION PROTON INTERACTIONS AT 3.2 AND 4.2 GEV/C

Suh Urk Chung (Ph.D. Thesis) 1966 143 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-5031

We have analyzed approximately 30,000 four-prong events at π^- beam momenta of 3.2 and 4.2 GeV/c, obtained with the 72-inch hydrogen bubble chamber at the Lawrence Radiation Laboratory. We present all the effective-mass distributions obtainable from the final states $p\pi^+\pi^-\pi^-$, $p\pi^+\pi^0\pi^-\pi^-$, and $n\pi^+\pi^+\pi^-\pi^-$, as well as the cross sections of these final states. In addition, we present the results of our study of the quasi-three-body final states $N^{*++}(1238)\pi^-\pi^-$, $p\pi^-\rho^0$, $p\pi^-\omega$, and $p\pi^-\eta$. We have given particular emphasis to the production and decay of the A_1, A_2 and B enhancements; the A_1 and B enhancements observed in our data are consistent with the interpretations as kinematic enhancements, and the A_2 enhancement can be interpreted only as a genuine resonant state. From the study of the decay angular correlations in the A_2 region as well as the control regions, we have determined that the lowest possible quantum numbers of the A_2 are $J^P = 2^+$. Dissert. Abstr.

N68-22130 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RESONANCE FORCED COMBINATIONAL SCATTERING [O REZONANSNOM VYNUZHDENNOM KOMBINATSIONNOM RASSEYANII]

P. A. Apanasevich and D. N. Ordabayev *In its* J. of Appl. Spectry. 11 Sep. 1967 p 1–15 refs (See N68-22129 12-23)

A quantum-mechnaical theory of stimulated resonance Raman scattering by a three-level system which takes into account the effect of the incident and the scattered radiation on the state and the properties of the molecules is developed. The analysis, based on the use of a density matrix in the dipole approximation, is performed for the case when $\omega_1 - \omega_2 = \omega_{21}$ where ω_1 and ω_2 are the angular frequencies of the two incident waves comprising the electromagnetic field, and ω_{21} is one of the natural frequencies of the molecule and applies to all values of field intensities. A general solution of the problem could not be obtained. However, for the stationary case the system of linear differential equations with constant coefficients was reduced to a system of algebraic equations which is identical to those obtained by the probability method. The solutions obtained show that for the radiation the frequencies of which (ω_1 and ω_2) obey the incident radiation causes not only the saturation effect, but also broadening and shifting of the Raman lines and a change in the probability of stimulated emission and absorption. Author

N68-22141 Virginia Polytechnic Inst., Blacksburg.

A DIGITAL COMPUTER TECHNIQUE FOR QUALITATIVE ANALYSIS OF COMPLEX SAMPLES FROM THEIR NEUTRON INDUCED GAMMA RAY ACTIVITIES

Clinton Howard Robins, Jr. (Ph.D. Thesis) 1967 142 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-6230

A digital computer technique has been developed for determination of the elemental constituents of an unknown specimen from a set of time-dependent gamma-ray spectra measured subsequent to neutron activation of the specimen. The technique is based on spectrum stripping which permits the analysis of samples of much greater complexity than is possible with existing computer procedures. In addition, the method is readily adaptable for use in automated activation analysis systems and is potentially capable of being modified for use with a quantitative analysis program. The requirements for application of the technique are essentially the same as those for any other method of neutron activation analysis. The primary disadvantage of the technique as compared with a previously developed spectrum stripping computer method is that the stripping operation must be performed a greater number of times. Dissert. Abstr.

N68-22150*# Oak Ridge National Lab., Tenn.

COMPARISON OF CALCULATED RADIOCHEMICAL CROSS SECTIONS WITH EXPERIMENTAL RESULTS FOR INCIDENT PROTONS AND NEGATIVE PIONS THE 50- TO 400-MeV REGION: EFFECT OF VARYING A FEW NUCLEAR PARAMETERS IN THE CALCULATIONS

Hugo W. Bertini Apr. 1968 59 p refs
(NASA Order 104(1); Contract W-7405-ENG-26)
(NASA-CR-94309; ORNL-4105) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Comparisons are made between theoretical predictions and experimental data for several incident proton reactions involving C, Al, Cu, and U and for the (π^-,π^-n) reaction in carbon. Interaction energies range from about 50 to 400 MeV. The theoretical model employs the two-step cascade-evaporation mechanism and includes the effect of the diffuse nuclear surface. The comparisons for the proton-initiated reactions indicate that agreement to within about 40% can be expected when the reaction cross section is about 100 mb, but the values can differ by factors of 5 or more when the cross section is about 10 mb. The agreement for the (π^-,π^-n) reaction on carbon was fair. This reaction can be used for the measurement of the real part of the optical-model potential, and the method for doing so is described. The effects of the diffuse nuclear surface in conjunction with changes in the nuclear radius on the (p,pn) reaction are discussed. Finally, results are given for the dependence of the (p,xpyn) cross sections on the transition energy used in the calculation between the cascade and evaporation processes. A tabulation of calculated and experimental cross sections, which includes all those used in this study, is attached as an appendix. Author

N68-22158# International Centre for Theoretical Physics, Trieste (Italy).

NEW SOLUTIONS OF THE THIRRING MODEL

C. R. Hagen (Rochester Univ.) Vienna Intern. Atomic Energy Agency Apr. 1967 21 p refs Submitted for publication
(IC-67-23) CFSTI: HC $3.00/MF $0.65

The device of the external source is used to evaluate the Green's functions of the Thirring model. The essential departure from earlier approaches to this problem consists in the use of a generalization of Schwinger's definition of the current operator for the case in which there exists a coupling to an external field. It is found that this definition is not sufficient to determine uniquely the current operator and that the solution consequently contains a free parameter which does not explicity appear in the original Lagrangian. Although the solution reduces to that obtained by Johnson for a particular value of this parameter, the present approach has the distinct advantage of avoiding time-like limits in the definition of the current as well as clearly indicating the existence of a more general class of solutions than has previously been known. The energy momentum tensor is displayed explicitly and is shown by direct calculation to satisfy Schwinger's commutator condition on the energy density. Author (ESRO)

N68-22161 California Univ., Berkeley.

SIGN OF THE $K_1^\circ - K_2^\circ$ MASS DIFFERENCE

Gerald Warren Meisner (Ph.D. Thesis) 1966 51 p
Available from Univ. Microfilms: HC $3.00/MF $0.65 Order No. 67-5120

We have performed an experiment to measure the sign of $m_1 - m_2$ by following the time development of $K_{\text{neutral}}p$ elastic scatters. We find K_2^0 to be heavier than K_1^0. Our statistical confidence level depends on the unresolved Fermi–Yang-type (F-Y) ambiguity that exists at present in the KN (strangeness S = +1) phase shifts in isotopic–spin state I = 0. If the F solution (large positive $p_{3/2}$ phase shift) is correct, we obtain Monte Carlo betting odds of 45 to 1 for $m_2 > m_1$, assuming $|m_1 - m_2| = 0.57\,\tau_1^{-1}$. If instead the Y solution (large positive $p_{1/2}$ phase shift) is correct, our betting odds for $m_2 > m_1$ are 5 to 1. We have not resolved the F-Y ambiguity. Dissert. Abstr.

N68-22168 Stanford Univ., Calif.

EXCITATION OF THE GIANT RESONANCES WITH MUONS AND ELECTRONS, AND NUCLEON EMISSION IN ELECTRON SCATTERING

Taber de Forest, Jr. (Ph.D. Thesis) 1966 150 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-4347

In this work we have considered several ways in which nuclear structure can be investigated in muon capture and electron scattering experiments. The first part concerns excitation of the giant resonance. It is shown that if the nucleon–nucleon interaction were independent of spin and isospin, the giant resonance for a closed shell nucleus would be a supermultiplet consisting of $J^{\pi}=0^-$, 1^- and 2^-, T=0 and 1 states. These processes were investigated in C^{12} and O^{16} using the particle-hole model of the nucleus. A spin dependent internucleon potential which fits low-energy nucleon–nucleon scattering was used. It was found that the most important contribution to the capture rate comes from the T=1 states. We have checked this quality for capture to these states using the particle-hole model and have found it to be valid to 3% for C^{12} and 10% for O^{16}. In the second part we have investigated electron scattering at large energy transfers and, in particular, considered what information can be obtained from coincidence experiments in which emitted nucleons are detected in addition to the electron. It is shown that the general form of the double coincidence cross section can be written as a linear combination for four generalized form factors which can be separated experimentally.

Dissert. Abstr.

N68-22191# International Centre for Theoretical Physics, Trieste (Italy).

PARTIALLY CONSERVED TENSOR CURRENT HYPOTHESIS AND THE PHOTOPION AMPLITUDE

Walter W. Wada (Ohio State Univ.) Vienna Intern. Atomic Energy Agency Mar. 1967 23 p refs Submitted for publication Sponsored in part by U.S. AEC Prepared for U.S. AEC
(Contract AT(11-1)-1545)
(IC-67-17) CFSTI: HC $3.00/MF $0.65

The partially conserved axial vector current (PCAC) and tensor current (PCTC) hypotheses and the resulting equal-time commutation relation of currents based on the quark model have been applied to the photopion amplitude at infinite collinear momentum limit. The current commutation relation gives rise to a contact interaction term in the amplitude characterized by an axial tensor current, of which the part due to the isoscalar photon interaction is free from ambiguities due to possible Schwinger terms, and gives correctly the low-energy limit of the amplitude. Author (ESRO)

N68-22193# International Centre for Theoretical Physics, Trieste (Italy).

ON THE COVARIANCE OF EQUAL TIME COMMUTATORS AND SUM RULES

C. G. Bollini (Fundacion Bariloche), J. J. Gianbiagi (Fundacion Bariloche), and J. Tiomno (Centro Brasil. de Pesquisas Fis.) Vienna Intern. Atomic Energy Agency Apr. 1967 15 p refs Submitted for publication
(IC-67-25) CFSTI: HC $3.00/MF $0.65

Conditions for covariance of equal time commutators are given. In momentum space they imply relations among the invariant amplitudes. It is shown that the most general expression for the sum rule, in any particular frame, is $\int d\tau n^{\mu} t_{\mu}(k^{\nu}+\tau n^{\nu})$ = form factor where n_{μ} is an arbitrary time-like vector. The covariance conditions are expressed by the fact that the integral is n-independent. In particular, Fubini's sum rule, which corresponds to a choice of n in the light cone, in spite of being covariant must be supplemented with a set of covariance conditions.

Author (ESRO)

N68-22196# International Centre for Theoretical Physics, Trieste (Italy).

MATRIX ELEMENTS OF NON-CENTRAL TWO-BODY NUCLEAR FORCES

G. Gmitro (Nucl. Res. Inst., Prague) Vienna Intern. Atomic Energy Agency Apr. 1967 13 p refs Submitted for publication
(IC-67-26) CFSTI: HC $3.00/MF $0.65

Explicit formulae are given for the two-particle matrix elements of tensor and spin-orbit interactions in the j-j coupling scheme. Some related computation problems are discussed. Author

N68-22197# International Centre for Theoretical Physics, Trieste (Italy).

THE WOODS–SAXON WAVE FUNCTIONS AND THE BETA TRANSITIONS OF DEFORMED NUCLEI

D. Bogdan (Inst. for Atomic Phys., Bucharest) Vienna Intern. Atomic Energy Agency Apr. 1967 29 p refs Submitted for publication
(IC-67-20) CFSTI: HC $3.00/MF $0.65

The general expressions for the beta transition matrix elements have been obtained using the Woods–Saxon wave functions for deformed nuclei proposed by Faessler and Sheline. As an application the matrix elements for the $1^-(\beta^-)0^+$ and $1^-(\beta^-)2^+$ transitions of the ^{170}Tm nucleus have been calculated. The results indicate significant differences between the Nilsson and Woods–Saxon values of the nuclear parameters. Assuming a reasonable K=0 mixture in the ground state of the ^{170}Tm nucleus and a value near to the Ahrens–Feenberg estimate for the $\int \alpha / \int r$ ratio it is possible to obtain an important improvement of the theoretical values of the relevant observables and especially of the ft values. Author

N68-22198# International Centre for Theoretical Physics, Trieste (Italy).

BARYON MASS SPLITTINGS IN AN SU(6)×O(3) QUARK MODEL

V. S. Bhasin (Delhi Univ.), D. L. Katyal (Delhi Univ.), and A. N. Mitra (Delhi Univ.) Vienna Intern. Atomic Energy Agency May 1967 30 p refs Submitted for publication
(IC-67-27) CFSTI: HC $3.00/MF $0.65

The positive and negative parity baryon mass shifts are investigated under the assumption that these particles belong respectively to the representations (56,1) and (70,3) of the group SU(6)×O(3), which are dynamically realizable from a 3-quark model with totally symmetric (S) functions, as found earlier by one of the authors. Two different types of SU(2) invariant central forces $V^{(1)}$ and $V^{(2)}$, each of which is shown to be in conformity with the usual mass relations for the 56 states, are employed. One of these forces $V^{(2)}$ is, however, found to violate the Gell–Mann–Okubo formula for certain negative parity octets. It is also found that appreciable mixtures of both $V^{(1)}$ and $V^{(2)}$ are necessary even for a qualitative representation of the experimental masses. The effect of an SU(2)-invariant spin-orbit force of the type $\tau_1 \cdot \tau_2$ of modest strength (≈25 MeV) is found to be very helpful in producing a reasonably good fit to the actual masses of the negative parity baryons. Such a force has, however, no first-order effect on the 56 masses, on the assumption of orbital S-functions, which can be constructed only with S-wave Q–Q pairs. Author

N68-22199# International Centre for Theoretical Physics, Trieste (Italy).

A NOTE ON THE LAMBDA–LAMBDA-HYPERNUCLEUS Λ–Λ C 14

Shamsher Ali (Atomic Energy Centre, Dacca), L. P. Kok (Groningen State Univ.), and M. E. Grypeos Vienna Intern. Atomic Energy Agency May 1967 11 p refs Submitted for publication
(IC-67-29) CFSTI: HC $3.00/MF $0.65

A three-body Λ–Λ–^{12}C analysis is made of the yet unobserved $\Lambda\Lambda$-hypernucleus ${}^{14}_{\Lambda\Lambda}$C for two ranges $\mu_{2\pi}^{-1}$ and μ_{K}^{-1} of the Λ–N interaction, using Λ–Λ potential strengths which are well determined from $^{6}_{\Lambda\Lambda}$He. It is suggested, on the basis of the present results, that an accurate experimental determination of $B_{\Lambda\Lambda}(^{14}_{\Lambda\Lambda}C)$ would be illuminating on the range and possibly also on the hard core of the Λ–N interaction. Author

N68-22204 California Univ., Berkeley.
FLUCTUATIONS OF ENERGY LOSS BY HEAVY CHARGED PARTICLES IN MATTER
Howard David Maccabee (Ph.D. Thesis) 1966 120 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-5107

Several theories predict the fluctuations of energy loss for different values of parameter κ. The Bohr theory, with modifications by Livingston and Bethe, predicts a symmetric Gaussian distribution around the mean energy loss, and is valid when $\kappa >> 1$. The Landau theory, with modifications by Blunck and Leisegang, is valid for $\kappa \leq .01$, and predicts a broad asymmetric distribution with a peak around the most probable energy loss (which is significantly less than the mean) and a long high-energy-loss tail. For the intermediate region of $.01 \leq \kappa \leq 1$, Symon has given an approximate and Vavilov an exact theory to predict the energy-loss distributions, which form a smooth transition between the Landau and Bohr distributions, but experimental data for establishing the validity of theory in this region are scarce. Within the limits of experimental error, very good agreement with the Vavilov theoretical distributions was found. Dissert. Abstr.

N68-22207 Western Reserve Univ., Cleveland, Ohio.
STUDY OF COLLECTIVE STATES OF NUCLEI BY INELASTIC ELECTRON SCATTERING
Chi-Shiang Wu (Ph.D. Thesis) 1966 105 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-4601

The collective excitation of nuclei by high energy electrons is studied using a microscopic model of the collective vibrational state of nuclei based on shell model particles interacting via residual forces, pairing plus quadrupole and octupole forces. In this paper, collective excitations from ground states to one phonon vibrational states are studied. In the first place, a complete interaction Hamiltonian, including nucleon convection and spin current, is used in a first Born approximation study of the scattering, which shows that the Coulomb interaction is dominant in the case of collective excitation even though it is not so in the case of a single-particle excitation. As a general conclusion, it is found that the scattering cross section is rather insensitive to the detailed structure of the nucleus in the low momentum transfer region, and that the electron scattering experiment must be extended to a sufficiently high momentum transfer region in order to see the effect of the detailed structure of the nucleus. Dissert. Abstr.

N68-22214*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
REDUCTION OF THE TWO-ELECTRON BREIT EQUATION
Penny G. Estabrooks 2 Nov. 1967 17 p refs
(Grant NsG-275-62)
(NASA-CR-94350; WIS-TCI-264) CFSTI: HC $3.00/MF $0.65 CSCL 20H

By means of a partitioning method similar to that applicable to the one-electron problem, the sixteen-component two-electron Breit equation is reduced for a four-component equation, involving only the large (i.e., positive energy) components of the wave function. The equation obtained by this method is compared to the results of a F–W transformation on the two-electron Hamiltonian. Author

N68-22219# International Centre for Theoretical Physics, Trieste (Italy).
QUARK MODEL COUPLINGS AND STRONG DECAYS OF TENSOR AND AXIAL MESONS
A. N. Mitra (Delhi Univ.) and P. P. Strivastava (Centro Brasil. de Pesquisas Fisicas) Vienna Intern. Atomic Energy Agency May 1967 8 p refs Submitted for publication
(IC-67-31) CFSTI: HC $3.00/MF $0.65

The quark model couplings of tensor, axial, and scalar mesons to PP and PV meson states have been evaluated under the assumption that the former have the $Q\bar{Q}$ structures $3p_{0,1,2}$ and $1p_1$. The results for the strong decay widths for the known modes are in rather good agreement with observations. Author (ESRO)

N68-22220# International Centre for Theoretical Physics, Trieste (Italy).
ON LIMITABLE DYNAMICAL GROUPS IN QUANTUM MECHANICS. 1: GENERAL THEORY AND A SPINLESS MODEL
H. D. Doebner (Marburg Univ.) and O. Melsheimer (Marburg Univ.) Vienna Intern. Atomic Energy Agency May 1967 52 p refs Submitted for publication
(IC-67-28) CFSTI: HC $3.00/MF $0.65

A pure group theoretical description of non-relativistic interacting systems in terms of irreducible representations U(D) of a dynamical group D is investigated. The description is complete in the sense that all observable quantities of the system can be calculated for U(D), much as the nonrelativistic free particle can be identified with an irreducible representation $U(G_E)$ of the central extension of the inhomogeneous Galilei group G_E. D depends on the interaction. It is a noninvariance group containing a spectrum-generating algebra. Physically motivated principles are proposed to connect an arbitrary abstract group with a complete description of an interacting system. It is assumed that the interaction can be turned off, which implies that U(D) and the physical representation $U(G_E)$ of the free particle group G_E can be limited into each other. If this limitation can be formulated without violating superselection rules, the group D is called a limitable group. A limitable D^1 is explicitly constructed by embedding the free particle group G_E into a larger group. A discussion of all embeddings leads to the special choice $D^1 \cong G_E^0$ (N) (x Sp(2N,R). A representation theory for D^1 is established. It is shown that D^1 is a limitable dynamical group and that the physical system described by D^1 and the physical representation can be calculated. The description is equivalent to nonrelativistic quantum mechanics for a spinless particle in N-dimensions with an arbitrary second-order polynomial in P_i, Q_i, $i = 1, \ldots, N$ as Hamiltonian. Author (ESRO)

N68-22221# International Centre for Theoretical Physics, Trieste (Italy).
FERMION TRAJECTORY PARAMETRIZATION AND SUPERCONVERGENCE
R. Ramachandran Vienna Intern. Atomic Energy Agency May 1967 15 p refs Submitted for publication Jointly prepared with California Univ., Riverside
(IC-67-30) CFSTI: HC $3.00/MF $0.65

A parametrization of nucleon and Δ trajectory is given, using both the position and the width of the resonances in a dispersion relation. The nucleon trajectory requires and accommodates a D wave resonance in the neighborhood of 1670 MeV. Another significant outcome of the scheme is that the Δ trajectory has an intercept, at W=0, of −0.69 and hence leads to a superconvergence relation for $\pi^- p$ scattering invariant amplitudes in the nearly backward direction (u=0). The resulting sum rules are satisfied only if there exists a strong attractive s-wave interaction (for example a σ meson) or other equivalent effects in the $\pi\pi$ – $N\bar{N}$ channel. Author (ESRO)

N68-22270 Virginia Univ., Charlottesville.
TWO PROBLEMS INVOLVING THE APPLICATION OF SU(3) THEORY TO NUCLEAR AND ELEMENTARY PARTICLE PHYSICS

Garold Joseph Borse (Ph.D. Thesis) 1966 157 p
Available from Univ. Microfilms: HC $7.40/MF $3.00 Order No. 67-3745

A calculation is made to relate the SU(3) production amplitude for the reaction $K^{+}+P \rightarrow K^{+}+K_{0}+\Omega^{-}$ to other reactions involving one meson, one baryon initial states and two meson one hyperon final states. The number of amplitudes involved in a single reaction is found to be too large to obtain any useful relations at present. However, by making a few assumptions several interesting relations between cross-sections have been obtained. The dynamics of the Ω^{-} are then discussed and it is concluded that the Ω^{-} may be viewed as a bound state of the ξK system. The simplified SU(3) classification scheme due to Elliott is used to describe the odd parity, five-particle/one-hole states of Ne^{20}. The wave functions are obtained by operating on a single intrinsic SU(3) function by a Wheeler projection integral. The energy levels calculated by diagonalizing a two by two matrix are found to resemble rotational bands with K=0, and 2, and the energy splittings are quite close to experimental results. Dissert. Abstr.

N68-22274 Polish Academy of Sciences, Warsaw.

STUDY OF THE REACTION $^{6}Li(d,p)^{7}Li$ INDUCED BY LOW ENERGY DEUTERONS [L'ETUDE DE REACTION $^{6}Li(d,p)^{7}Li$ INDUITE PAR LES DEUTERONS DE BASSES ENERGIES]

I. M. Turkiewicz, J. Turkiewicz, A. Turos, I. A. Capurcenko (Joint Inst. for Nucl. Res., Dubna, USSR), and B. Fryszczyn (Warsaw Univ.) 1967 21 p refs In FRENCH
(IBJ-849/1/PL) CFSTI: $3.00

Angular distributions are measured for the protons from the reactions of $^{6}Li(d,p_{0})Li^{7}$ and $^{6}Li(d,p_{1})Li^{7}$ for deuteron energies of 1.48, 1.80, 2.04, 2.27, 2.49, 2.66, and 2.94 MeV. These distributions were compared with some results previously obtained by the stripping theory of Butler and the diffraction theory of Dar. It was found that these theories did not give results that agreed with those obtained experimentally. Transl. by M.W.R.

N68-22282# International Centre for Theoretical Physics, Trieste (Italy).

CURRENT DEFINITION AND MASS RENORMALIZATION IN A MODEL FIELD THEORY

C. R. Hagen (Rochester Univ.) Vienna Intern. Atomic Energy Agency Apr. 1967 25 p refs Submitted for publication
(IC-67-24) CFSTI: HC $3.00/MF $0.65

It is demonstrated that a field theory of vector mesons interacting with massless fermions in a world of one spatial dimension has an infinite number of solutions in direct analogy to the case of the Thirring model. Each of these solutions corresponds to a different value of a certain parameter Ξ which enters into the definition of the current operator of the theory. The physical mass of the vector meson is shown to depend linearly upon this parameter attaining its bare value μ_0 for the exceptional case in which the pseudo-vector current is exactly conserved. The limits $\mu_0{}^2 \rightarrow \infty$ and $\mu_0{}^2 \rightarrow 0$ are examined, the former yielding results previously obtained for the Thirring model while the latter implies a unique value for Ξ and defines the radiation gauge formulation of Schwinger's two-dimensional model of electrodynamics. Author (ESRO)

N68-22293 Rensselaer Polytechnic Inst., Troy, N. Y.

CALCULATION AND INTERPRETATION OF NEUTRON THERMALIZATION IN FINITE BLOCKS OF BERYLLIUM

Robert Roy Lee (Ph.D. Thesis) 1966 143 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-4172

This theoretical investigation of the time dependence of a neutron pulse in finite beryllium assemblies uses the eigenvalue-eigenfunction method, with the energy treated as a discrete ordinate, to analyze experimental measurements in the buckling range B^2 = .0131 cm $^{-2}$ to .124 cm $^{-2}$. For assembly sizes that do not have a discrete or asymptotic mode (B^2 > .03 cm $^{-2}$); the time dependent flux is shown to be dominated by a pseudo-fundamental eigenvalue-eigenfunction that is actually part of the continuum spectrum. This gives rise to an essentially single exponential decay of the time dependent flux in the time range of interest to the experimenter and is a quantitative explanation of why measured eigenvalues for small systems appear to violate the continuum limit. $(v\Sigma)_{min}$. The pseudo-fundamental eigenfunction has peaks corresponding to Bragg peaks in the cross-section and describes a trapping of neutrons at these energies. Dissert. Abstr.

N68-22337# International Centre for Theoretical Physics, Trieste (Italy).

PHENOMENOLOGICAL α–α POTENTIAL AND THE GROUND STATE OF Be^{8}

Skamsher Ali (Atomic Energy Center, Dacca) and S. A. Afzal (Atomic Energy Centre, Dacca) Vienna Intern. Atomic Energy Agency Apr. 1967 8 p refs Submitted for publication
(IC-67-22) CFSTI: HC $3.00/MF $0.65

It is shown here that a phenomenological S-state α–α potential whose attractive part is carefully determined from the G-wave α–α scattering which, in fact, is a probe for this part can, besides explaining α–α scattering, account fairly well for the ground state parameters of Be^{8}. Author

N68-22352# National Research Council of Canada, Ottawa (Ontario).

PASSAGE OF HIGH ENERGY NEUTRONS IN IRON AQUEOUS MIXTURES [PROKHOZHDENIE NEITRONOV VYSOKIKH ENERGII V ZHELEZOVODNYKH SMESYAKH]

B. S. Sychev, V. V. Mal'kov, M. M. Komochkov, and L. N. Zaitseva 1967 15 p refs Transl. into ENGLISH from the Publ. "Ob'edinennogo Instituta Yadernykh Issledovanii" Dubna, Joint Inst. for Nucl. Res., 1965
(NRC-TT-1278) CFSTI: $3.00

Attenuation of neutron fluxes generated by protons with energies of 170, 250, 350, 480, and 660 MeV was studied in iron and iron-aqueous mixtures. The spectrum of neutrons falling on the shielding corresponded to proton energies of 350 and 660 MeV. The exponential nature of attenuation of neutron fluxes greater than 20 MeV in the section of shielding from 2×10^{3} to 10^{4} kg/m $^{-2}$ made it impossible to determine the length of relaxation in iron-aqueous mixtures. An equilibrium of investigated neutron energy groups was established for the aqueous mixtures on shielding of 2×10^{3} kg/m $^{-2}$ in thickness, although no equilibrium was established between the high energy fluxes and the resonance neutrons in pure iron. M.W.R.

N68-22360 California Univ., Berkeley.

A STUDY OF MULTICHANNEL DYNAMICS IN THE NEW STRIP APPROXIMATION

Shu-yuan Chu (Ph.D. Thesis) 1966 55 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-5029

A systematic study of the dynamics of scattering with several coupled two-particle channels is made using the new strip approximation. The existence of a unique solution to the ND^{-1} equations is established from maximal analyticity of the second degree. The method used is an extension of Jones' proof in the single-channel case, making use of an explicit expression for the determinant of D constructed by Gross. The general method is then applied to the particular case of a $\pi\pi$-KK two-channel calculation of the ρ-meson, first with fixed-spin particle and then with Reggeized particle exchange as the generalized potential. A detailed discussion of the numerical result is presented with the conclusion that the effect of the inelastic channel ($K\bar{K}$) is not important in the present approximation scheme. Dissert. Abstr.

N68-22361 California Univ., Los Angeles.
OBSERVABLE EFFECTS OF THE BOX SINGULARITY
Peter Collas (Ph.D. Thesis) 1966 101 p
Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-4490

The effect of the leading Landau singularity of the fourth-order single-loop graph in a two-particle → four-particle amplitude is investigated. The amplitude for the graph is evaluated from a dispersion relation in the mass squared of the two particles interacting in the final state, and its behavior is studied using a simple model. The reactions $\bar{p}p \rightarrow \bar{K}K\pi\pi$ and $\bar{p}p \rightarrow \bar{\Lambda}\Lambda\pi^+\pi^-$ are examined in some detail, and peaks are predicted for the amplitude squared in a certain range of the external variables. Dissert. Abstr.

N68-22362 Stanford Univ., Calif.
THE PHOTOPRODUCTION OF K^+ MESONS FROM HYDROGEN NEAR THRESHOLD
James Norris Bradbury (Ph.D. Thesis) 1966 98 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-4322

The near threshold photoproduction of the $K^+\Lambda$ system from hydrogen has been studied using a bremsstrahlung beam from the Stanford Mark III accelerator. Measurements of the angular distribution of the reaction cross section were made in the center-of-mass angular interval from 50° to 130° at a laboratory photon energy of 940 MeV. Two cross sections at photon energy 975 MeV were also measured to check agreement with data obtained elsewhere. The K mesons were selected with a magnetic analyzer and counter telescope system, and both range and time-of-flight criteria were utilized to aid in the rejection of pions and protons. The final K meson identification was made on the basis of the correlated pulse heights in the counter telescope. The observed angular distribution at photon energy 940 MeV is isotropic implying, in conjunction with other data, S-wave production. The results are compared to the predictions of a particular phenomenological resonance model for the reaction. Dissert. Abstr.

N68-22365# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
REMARKS ON LOW-ENERGY PION-NUCLEON SCATTERING
J. J. Sakurai Dec. 1967 10 p Submitted for publication
(Contract AT(11-1)-264)
(EFINS-67-96; COO-264-412; CONF-671203-3) CFSTI: HC $3.00/MF $0.65

From the review given of meson (π)–nucleon interaction theory it is concluded that the advances in PCAC and current algebra essentially justify the conjecture that the low-energy scattering amplitude is due to the nucleon Born term computed according to the gradient coupling prescription plus the ρ exchange term computed in accordance with the universality principle. It is postulated that the basic problems of the discussed meson (π)–nucleon scattering lengths are solved. NSA

N68-22368# Arizona Univ., Tucson.
[NUCLEAR PHYSICS] Progress Report, 1 Jan.–31 Dec. 1967
D. J. Donahue, J. D. McCullen and L. C. McIntyre 31 Dec. 1967 8 p refs
(Contract AT(11-1)-1468)
(COO-1468-2) CFSTI: HC $3.00/MF $0.65

The determination of unattenuated Doppler shifts for nuclear γ transitions was investigated. Doppler shifts of γ rays from ^{20}F, ^{26}Mg, and ^{29}Si were measured; values for the lifetimes of states in ^{20}F and ^{29}Si were obtained. The energy levels of ^{42}Sc were investigated using the reaction ^{40}Ca(He-3,p)^{42}Sc, and an experimental attempt to observe isobaric spin mixing in the decay of ^{42}Sc was begun. Development of the polarized ion source continued. NSA

N68-22369# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Physics.
SOME CONSEQUENCES OF THE PROPERTIES OF THE INTERNAL SYMMETRY CROSSING-MATRICES
Herbert Kottler (Ph.D. Thesis) Sep. 1967 178 p refs
(Contract AT(11-1)-1573)
(COO-1573-31) CFSTI: HC $3.00/MF $0.65

The general properties of the internal symmetry crossing matrices for an arbitrary compact internal symmetry group are investigated. Then the consequences of these properties are considered in three problems where the crossing matrices play an important role. In the first, a statistical model for high energy, large angle two-particle scattering with which one can calculate average branching ratios is formulated. The crossing matrices enter into this model through the requirement that the average cross section be independent of the channel through which one views the reaction. Next, a u-channel dominance theorem is proven which, in essence, states that the only single internal symmetry reduced amplitude that can dominate the u-channel contribution to an s-channel process is that reduced amplitude which corresponds to the maximum weight representation in the u-channel. This theorem is the u-channel analogue of the t-channel dominance theorem of Amati, et al. Finally, the role which the elements of the crossing matrices play in a simple self bootstrap model for a scalar particle is studied. Author (NSA)

N68-22372# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
[LOW ENERGY NUCLEAR PHYSICS AND PHYSICS OF ATOMIC AND IONIC BEAMS] Final Report, 1952–1966
27 Dec. 1967 7 p refs
(Contract AT(11-1)-238)
(COO-238-51) CFSTI: HC $3.00/MF $0.65

A summary of the completed research program on low-energy nuclear reactions induced by light charged particles and on the interaction of atomic and ionic beams with matter is presented. NSA

N68-22374# Stanford Univ., Calif. Linear Accelerator Center.
PHOTOMONOPRODUCTION OF POSITIVELY-CHARGED π MESONS BETWEEN 1.2 AND 3 GEV IN THE LABORATORY ANGLE REGION FROM 8°–20° [PHOTOEINFACHPRODUKTION POSITIV GELADENER π-MESONEN ZWISCHEN 1.2 UND 3 GEV IM LABORWINKELBEREICH VON 8°–20°]
P. Schmueser Jun. 1967 130 p refs Transl. into ENGLISH from German
(SLAC-TRANS-68; NP-16741) CFSTI: HC $3.00/MF $0.65

The reaction $\gamma + p \leftarrow \pi^+ + n$ was investigated. The differential cross sections show resonance structure in the energy region corresponding to the nucleon isobars. At photon energies above 1.7 GeV, the cross sections $d\sigma/dt$ drop nearly exponentially as functions of four-momentum transfer. Theoretical models are only partly successful in describing the experimental behavior. The simple peripheral model predicts a t-dependence which strictly disagrees with the results. If final-state absorption is taken into account the situation is considerably improved, but still the decrease of $d\sigma/dt$ with $|t|$ is less rapid than experimentally observed. However, this absorption model gives the correct order of magnitude for the cross sections. Interpretation in terms of Regge-π-exchange does not seem to be adequate since there is still resonance structure in the energy region considered. The vector–meson dominance model predicts values for the total cross sections which agree with the experimental results within a factor of two. Also a predicted t-dependence at 1.7 GeV is in qualitative agreement. Author (NSA)

N68-22375# Argonne National Lab., Ill.

ANGULAR ANISOTROPY AND THE EFFECT OF NUCLEON PAIR CORRELATION DURING THE FISSION OF NUCLEI BY NEUTRONS [UGLOVAYA ANIZOTROPIYA I EFFEKTY PARNOI KORRELYATSII NUKLONOV PRI DELENII YADER NEITRONAMI]

G. N. Smirenkin, V. G. Nesterov, and A. S. Tishin Dec. 1967 21 p refs Transl. into ENGLISH from Russian Report no. FEI-67
(ANL-TRANS-550; FEI-67)

The energy dependence of the angular anisotropy of the fission of ^{233}U, ^{235}U, and ^{239}Pu with neutrons and of ^{233}U with α particles was discussed. In conformance with the statistical theory of the angular distribution of the fragments, the dependence of the mean square of the projection of the moment of the compound nucleus on the fission axis K^2 on the excitation energy E at the saddle point was obtained. The analysis of the dependence $K^2(E)$ made it possible to determine for ^{240}Pu at the deformed surface the state of the critical energy as $E_{\sigma} = 9.5 \pm 3$ MeV from which originated the transition from the superfluid phase to the normal and the size of the energy gap in the spectrum of the internal excitation as $2\Delta_0 = 1.5 \pm 0.3$ MeV. The values obtained were significantly lower than the last data on these magnitudes. It was shown that the rate of regression to the Fermi gas model was dependent on the effects of the correlation of the nucleons and was significantly lower than was assumed earlier. Author (NSA)

N68-22386# California Univ., Berkeley. Lawrence Radiation Lab.

NUCLEON-NUCLEON SCATTERING EXPERIMENT AT INTERMEDIATE ENERGIES IN BERKELEY

David Cheng Mar. 1967 24 p refs Presented at Am. Phys. Soc., Nucleon-Nucleon Interaction Conf., Gainesville, Fla., 23 Mar. 1967 Revised
(Contract W-7405-ENG-48)
(UCRL-17408, Rev.; CONF-670302-8) CFSTI: HC $3.00/MF $0.65

Various N+N experiments are described. The energies studied range from about 310 to 740 MeV. The polarization parameter is the primary object of study, and results on polarization and angular distributions are shown for the various experiments. NSA

N68-22388*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

EXCITATION AND IONIZATION OF POSITIVE HELIUM ION (IS) BY ELECTRON IMPACT

H. Lee Kyle and K. Omidvar May 1968 10 p refs
(NASA-TM-X-63182; X-641-68-151) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The binary collision approximation has produced satisfactory agreement between theory and experiment for excitation and ionization of neutral atoms by electrons, especially for the intermediate and high incident energies. It is of interest to test the validity of the theory for excitation and ionization of ions by electrons. In this paper the theory has been applied to such processes for He^+. Author

N68-22394# Stanford Univ., Calif. Liner Accelerator Center.

EXPERIMENTAL PROGRAM AT THE STANFORD LINEAR ACCELERATOR CENTER

R. Diebold Jan. 1968 49 p refs
(Contract AT(04-3)-515)
(SLAC-PUB-369) CFSTI: HC $3.00/MF $0.65

The present status of the experimental high-energy physics program at SLAC is discussed. The experimental arrangements are described, together with those preliminary results already obtained. Author (NSA)

N68-22404# Univ. of Southern Calif., Los Angeles. Nuclear Physics Lab.

ANNUAL PROGRESS REPORT ON NUCLEAR PHYSICS, 1 OCTOBER 1966-30 SEPTEMBER 1967

Oct. 1967 59 p refs
(Contract AT(04-3)-136)
(USC-136-132) CFSTI: HC $3.00/MF $0.65

Some investigations of proton-induced reactions on light and medium-weight nuclei are summarized, together with studies of the effects of nuclear reactions on the efficiency of Ge and Si detectors for protons of 5 to 150 MeV. The effect of $\Lambda N \leftrightarrows \Sigma N$ processes on the binding energy of $_{\Lambda}H^3$ was studied theoretically. Scattering chambers with radii of 12 and 16 in. were developed for angular correlation and scattering experiments and for studies of few-nucleon pickup reactions. NSA

N68-22407# Stanford Univ., Calif. Linear Accelerator Center.

DEPENDENCE OF STORAGE RING LUMINOSITY ON THE REGION WIDTH AND ON THE CROSSING ANGLE [ABHAENGIGKEIT DER SPEICHER-RING-LUMINOSITAET VON DER TAILLENWEITE UND VOM KREUZUNGSWINKEL]

A. Piwinski Jun. 1967 25 p refs Transl. into ENGLISH from GERMAN
(SLAC-TRANS-67; DESY-67-7)

The storage ring luminosity as limited by the beam-beam space charge interaction is calculated, taking into account the crossing angle, the shape of the amplitude function in a low-β-region and the dependence of the Q-shift on the position of the particle within the bunch. It appears that there is an optimum value β_0 for which the luminosity has a maximum. With increasing crossing angle and given beam size, the Q-shift falls off more rapidly than the luminosity. By adjusting the beam cross section for constant Q-shift, an increase of luminosity with increasing crossing angle is obtained. Author (NSA)

N68-22410 Lockheed Missiles and Space Co., Sunnyvale, Calif.

METHOD OF SOLVING THE WAVE EQUATION WITH ADDITIVE POTENTIAL

A. I. Rezanov 1967 4 p Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 7, no. 3, 1967 p 691-694

A method is proposed for the determination of quantum states of particles moving in the potential field of two systems of force centers. Its own partial mass corresponds to the particle motion in each partial field. An energy spectrum is constructed from the energy levels in the partial fields by a special selection of the values of the partial particle masses. The wave function is represented as an expansion in a system of functions in one of the partial fields. The condition of solvability of the system of equations for the expansion coefficients connects the force center coordinates to the quantum numbers. Author

N68-22419# California Univ., Berkeley. Lawrence Radiation Lab.

RESONANCE PRODUCTION IN π^+p INTERACTIONS BETWEEN 3 AND 4 GEV/C

G. Gidal, D. Brown, R. W. Birge, R. Bacastow, S. Y. Fung et al 26 Dec. 1967 18 p refs Presented at 3d Topical Conf. on Resonant Particles, Athens, Ohio, 22-24 Nov. 1967
(Contract W-7405-ENG-48)
(UCRL-17984; CONF-671122-2) CFSTI: HC $3.00/MF $0.65

Two experiments from an exposure of a hydrogen bubble chamber to mesons (π^+) 2.95 to 4.1 GeV/c are reported. The first is observation of B enhancement using 9400 events of the type $\pi^+ + p \rightarrow \pi^+ + p + \pi^+ + \pi^- + \pi^0$. The second is the decay of $N^* \rightarrow \Delta^{2+} + \pi^-$ from 7800 events of the type $\pi^+ + p \rightarrow \pi^+ + p + \pi^+ + \pi^-$. The $\omega\pi$ mass spectrum showing the B enhancement of about 150 events above background near 1230 MeV is presented. The distribution of $M(\Delta^{2+}\pi^-)$ for all events among five energies is shown. NSA

N68-22426*# Wisconsin Univ., Madison. Physics Dept.

THE APPLICATION OF PERTURBATION THEORIES FOR EXCHANGE FORCES TO A SIMPLE MODEL

S. T. Epstein and R. E. Johnson 3 Nov. 1967 16 p refs
(Grant NsG-275)
(NASA-CR-94334; WIS-TCI-265) CSCL 20H

Convergence was examined for several methods of obtaining an appropriate perturbation theory for energy exchange. The methods were used to derive a simple, soluble mathematical model. Perturbation schemes were applied to the ground state of the model. Results are compared for two resolutions of the field. A brief discussion is given on the various perturbation theories, and the exact forms for the energy as a function of the dummy perturbation parameters are listed. E.C.

N68-22434# Uppsala Univ. (Sweden). Inst. of Physics.

ELECTRON BINDING ENERGIES IN PLATINUM

S.-E. Karlsson, C.-H. Norberg, O. Nilsson, S. Hogberg, A. H. El-Farrash et al Jul. 1967 20 p refs Supported in part by Statens Naturvetenska Naturvetenskapliga Forskningsrad, Sweden
(UUIP-553)

The 50-cm iron-free spectrometer at Uppsala was adapted to ESCA studies. The energies of all L, M, and N, and some O atomic levels in platinum were precisely determined using this instrument. No evidence for the recently reported L_{II} binding energy anomaly was found. Author (NSA)

N68-22435# Uppsala Univ. (Sweden). Inst. of Physics.

THE DECAY OF ^{90}Nb

H. Petterson, S. Antman, and Y. Grunditz Sep. 1967 33 p refs
(UUIP-555)

The decay of 14.60 ± 0.05-hr ^{90}Nb was investigated with a double-focusing iron-yoke spectrometer and with a Ge(Li) detector. The end-point energy of the intense (53 ± 6%) positron branch was determined to be (1500 ± 4) keV, leading to a Q-value of 6111 ± 4 keV. Seventeen transitions were found in the internal conversion spectrum, and among these six are not previously reported at 518, 828, 1575, 1717, 1914, and 2223 keV. The K-conversion coefficients were determined by combining the internal conversion intensities with the gamma-ray intensities. For many transitions, probable multipolarity assignments were obtained from these coefficients and also from $K/\Sigma L$ and $L_I/L_{II} + L_{III}$ ratios. The M-conversion intensities of the 133- and 141-keV transitions were found to be in agreement with the recent tabulations of Hager and Seltzer. All transitions observed were fitted into a tentative decay scheme, which in its lower part is in agreement with shell-model calculations. Author (NSA)

N68-22438# Princeton-Pennsylvania Accelerator, Princeton, N. J. Palmer Physical Lab.

DOUBLE CHARGE EXCHANGE SCATTERING OF POSITIVE π MESONS ON COMPLEX NUCLEI

Paul Edward Boynton Apr. 1967 175 p refs
(Contract AT(30-1)-2137)
(PPAD-633F) CFSTI: HC $3.00/MF $0.65

The differential cross section for the reaction $\pi^+ + N(z,n) \rightarrow \pi^- + X$ was measured at lab angles of 7.5 and 15° with incident 200-MeV π^+ derived from the external proton beam of the UCLRL 184" synchrocyclotron. Several target nuclei were employed: ^{51}V, ^{90}Zr, ^{7}Li. The momentum analysis of the final-state π^- was accomplished with a magnetic spectrometer using digitized wire spark chambers for track location. Recent theoretical papers indicate the possibility of exciting $\Delta_{z}^{+} - 2$ isobaric analogue states (for which $X = N(z+2, n-2)$—a two body final state). The data obtained show no evidence of this state and provide an upper limit of 1 to 2 μb/sr on its excitation at both 7.5 and 15°, the contribution to the cross section from all final states is 40 to 60 μb/sr for the various targets and angles and for $110 < T_{\pi^-} < 200$ MeV. The discrepancy between theory and experiment is discussed in terms of a pion-complex nucleus interaction model including effects of higher-order inelastic scattering. Author (NSA)

N68-22447# Gulf General Atomic, San Diego, Calif.

SINGLE DIFFERENTIAL CROSS SECTION OF ZIRCONIUM HYDRIDE

Gary Walter Carriveau (M.S. Thesis—San Diego State College) Jun. 1967 108 p refs
(Contract AT(04-3)-167)
(GA-8345) CFSTI: HC $3.00/MF $0.65

A single differential scattering cross section of zirconium hydride was measured at 296 and 700°K to complement room-temperature measurements previously made. A specially constructed sample holder and oven was used. A neutron transmission measurement was made before and after heating to determine the change in sample composition. The measurements were performed at 700°K over an angular range of 20° to 155° and at 296°K from 80° to 155°. A pulsed source of neutrons was produced using an electron linear accelerator. The energy of the neutrons used ranged from 0.008 to 1.0 eV and was measured using the time-of-flight method. Several correction methods were used in the analysis of the data including a correction for multiple scattering in the sample. The results show that the multiple scattering correction method is valid at this sample thickness. The correction methods are discussed. The results show that the single differential cross section of zirconium hydride is temperature dependent. It can be concluded that the broadened Einstein level and acoustical mode model best describes the thermalization of neutrons in zirconium hydride for a wide range of temperatures. Author (NSA)

N68-22449# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton. Rutherford High Energy Lab.

NEUTRON SPECTROMETRY FROM 0.025 EV TO 25 GEV

G. R. Stevenson Nov. 1967 41 p refs
(RHEL/R-154) CFSTI: HC $3.00/MF $0.65

An iterative unfolding method for response matrices was applied to the determination of neutron spectra from multisphere and activation analysis, and the work of Awschalom (PPAD-596E) was extended in that rules have been evolved for terminating the iteration sequence. Tests using analytic spectra to generate the detector responses used as input to the method indicate that confidence can be placed in the synthesized spectra when used with multisphere detectors, but that the method is unsatisfactory when used with activation detectors. Author (NSA)

N68-22458# Idaho Nuclear Corp., Idaho Falls.

MACS J: A PROGRAM FOR COMPUTING CRYSTAL PHONON DISPERSION RELATIONS, STRUCTURE FACTORS FOR NEUTRON INELASTIC SCATTERING, AND JACOBIAN MATRICES

J. K. Boyter and A. W. Solbrig, Jr. Jan. 1968 23 p refs
(Contract AT(10-1)-1230)
(IN-1147) CFSTI: HC $3.00/MF $0.65

A FORTRAN IV program MACS J (PPCo40*0929) is described which computes (a) the dynamical matrix for the harmonic oscillations of a crystal, (b) the eigenvalues and eigenvectors of this matrix, (c) the corresponding structure factors for coherent single-phonon scattering of neutrons, and (d) Jacobian matrices for use in adjusting force constants to fit calculated dispersion curves to observed dispersion curves. Appendixes contain discussion of fitting procedures and the linearity assumption as well as sample input for calculation of a Jacobian matrix. Running time on an IBM 7044 (32K, batch processing) for the 7 problems required to calculate a Jacobian with 8 rows and 6 columns for BeO (4 atoms per primitive cell) is less than 5 minutes. Author (NSA)

N68-22460# Los Alamos Scientific Lab., N. Mex.

TOTAL REACTION CROSS SECTIONS FOR PROTONS BETWEEN 10 MEV AND 22 MEV ON C 12 AND Ca 40

John F. Dicello, Jr. (Ph.D. Thesis—Texas A&M Univ.) 31 Jan. 1968 148 p refs
(Contract W-7405-ENG-36)
(LA-3842) CFSTI: HC $3.00/MF $0.65

Total reaction cross sections for protons on ^{40}Ca were measured at fifteen energies between 10.3 and 21.6 MeV by the beam-attenuation method. The differential elastic cross sections for protons on ^{40}Ca were obtained at fifteen energies between 9.8 and 21.7 MeV. These measurements were made at intervals of 3° between 12 and 30° and at intervals of 5° between 35 and 165° in the laboratory. Total reaction cross sections for protons on carbon were measured at ten energies between 9.8 and 19.5 MeV. The total reaction cross section for ^{40}Ca rises sharply at low energies, reaches a maximum value around 13 MeV, and reaches a minimum around 16 MeV. The rise at the lower energies is a result of the Coulomb barrier. The dip at 16 MeV is probably associated with the (p,n) threshold at 16 MeV. The present differential elastic cross sections and total reaction cross sections for ^{40}Ca are compared with predictions of the optical model. The total reaction cross sections for carbon show resonant-like structures in the neighborhood of 10.4 and 13.8 MeV. The structure observed in these total reaction cross sections is related to levels around 11.6 and 14.6 MeV in the compound nucleus ^{13}N. Because of the presence of these sharp resonances in the total reaction cross section, it does not seem reasonable to apply the optical model to ^{12}C at lower energies. Author (NSA)

N68-22511# Brookhaven National Lab., Upton, N. Y.

THE STUDY OF 28.6 GEV/C p–p INTERACTIONS WITH 6 CHARGED PARTICLES IN THE FINAL STATES

P. L. Connolly, I. R. Kenyon, T. W. Morris, and A. M. Thorndike Nov. 1967 18 p refs Presented at the Topical Conf. on High Energy Collisions of Hadrons, Geneva
(BNL-11993; CONF-680103-5) CFSTI: HC $3.00/MF $0.65

Results from a study of high-multiplicity high-energy p + p interactions at 28.6 GeV/c in a hydrogen bubble chamber are described. The measurements of 29,500 pictures yielded 5230 well-reconstructed events. Mass distributions are shown from which the dominance of Δ (1236) is noted. Also considerable enhancement appears from 1440 to 1760 GeV which is not inconsistent with the known large decay rates of the N(1525) and N(1670). The 1-constraint fits show the presence of ω production in the reaction $p + p \rightarrow 2p + 2\pi^+ + 2\pi^- + \pi^0$. It is observed that the reaction $p + p \rightarrow 2p + 2\pi^+ + 2\pi^-$ shows several simple features which are consistent with dominance of the reaction by diffraction dissociation of the protons. But this dominance is not established by these features. NSA

N68-22512# Brookhaven National Lab., Upton, N. Y.

PARAMETERS OF THE STRUCTURE OF THE NEUTRON FORCE FUNCTION OF MEDIUM AND HEAVY NUCLEI

S. I. Sukhoruchkin Jan. 1968 8 p refs Presented at the Nucl. Data Reactors Conf., Paris, 1966
(BNL-TR-189) CFSTI: HC $3.00/MF $0.65

To obtain reliable values of the force functions when averaging the neutron widths of the individual resonances, it is necessary to fulfill the condition that the averaging interval exceed the characteristic energy period of modulation of the neutron widths, which is related to single-particle effects in the entrance channel. The results of our analysis of the experimental data with a view of determining the parameters of the single-particle structure of the neutron force function are presented. Author (NSA)

N68-22534# Joint Publications Research Service, Washington, D. C.

PHOTOCONDUCTIVITY AND QUANTUM YIELD IN GERMANIUM UNDER THE ACTION OF ROENTGEN RADIATION

M. G. Kamoldinov 6 May 1968 8 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Fiz. (Tomsk), No. 3, 1967 p 22–26
(JPRS-45278)

An investigation is made of the photoconductivity in germanium, induced by roentgen pulses. The excitation of the photoconductivity is characterized by the actual quantum yield. Author

N68-22543# Oak Ridge National Lab., Tenn. Neutron Physics Div.

O5S: A MONTE CARLO CODE FOR CALCULATING PULSE HEIGHT DISTRIBUTIONS DUE TO MONOENERGETIC NEUTRONS INCIDENT ON ORGANIC SCINTILLATORS

R. E. Textor and V. V. Verbinski Feb. 1968 222 p refs
(Contract W-7405-ENG-26)
(ORNL-4160) CFSTI: HC $3.00/MF $0.65

O5S is a Monte Carlo code which directly simulates the experimental techniques used to obtain the pulse height distribution for a parallel beam of mono-energetic neutrons incident on organic scintillator systems. In large part the code is patterned after the far more general code O5R and, for the sake of brevity, at least passing familiarity with that code is assumed. Due to the nature of the specialization which O5S represents, a considerable amount of the memory storage required for O5R is avoided allowing the analysis of neutron events as they occur rather than after all have occurred. Although the code, as here presented, is capable of calculating the pulse height distribution for neutron energies in the range 20 keV to 70 MeV, experimental verification presently exists for the range 200 keV to 20 MeV. The code was written primarily in the FORTRAN 63 langugage for the CDC 1604-A computer. Author (NSA)

N68-22546# Gulf General Atomic, San Diego, Calif.

NEUTRON CROSS SECTIONS FOR Pa-231, Pa-233, AND U-232

M. K. Drake and P. F. Nichols 8 Sep. 1967 83 p refs
(Contract AT(04-3)-167)
(GA-7462) CFSTI: HC $3.00/MF $0.65

A survey was made of the available experimental cross-section measurements for ^{231}Pa, ^{233}Pa, and ^{232}U. Sets of recommended neutron cross sections and resonance parameters are presented for neutron energies from 0.001 eV to 15 MeV. Author (NSA)

N68-22552# California Inst. of Tech., Pasadena.

REGGE POLES AND HIGH ENERGY π N SCATTERING

Steven Frautschi Dec. 1967 25 p refs Presented at πN Scattering Conf., Irvine, Calif., Dec. 1967
(Contract AT(11-1)-68)
(CALT-68-145; CONF-671203-2) CFSTI: HC $3.00/MF $0.65

A review is given of the outstanding structural features from attempts to understand higher energy scattering by means of Regge poles, much as first, second, third resonance were outstanding in the low-energy scattering. The case of $\pi^- + p \rightarrow \pi^0 + n$ interactions at small t is analyzed. Elastic $\pi^+ + p$ and $\pi^- + p$ scattering are also considered. NSA

N68-22553# Commissarait a l'Energie Atomique, Saclay (France).

ASSOCIATIVE MEMORIES IN NUCLEAR PHYSICS [LES MEMOIRES ASSOCIATIVES EN PHYSIQUE NUCLEAIRE]

Ernest Blanca and Andre Carriere Dec. 1967 43 p refs In FRENCH
(CEA-R-3394) CFSTI: HC $3.00/MF $0.65

Experiments in nuclear physics involve the use of large size memories. After showing the difficulties arising from the use of such memories, this paper lists the principles of the various programming methods which make it possible to operate the memories associatively thus benefitting from a reduction in size and better operational conditions. Considered are the shape and dimensions of an associative memory with cable connections which could be designed specially for nuclear research. Author

N68-22561# Los Alamos Scientific Lab., N. Mex.

CALCULATION OF NEUTRON POLARIZATIONS USING A LOCAL OPTICAL POTENTIAL WITH AVERAGE PARAMETERS

Jerome G. Beery, Katherine H. Harper, Virginia M. Stovall, and Louis Rosen 2 Feb. 1968 397 p refs
(Contract W-7405-ENG-36)
(LA-3788) CFSTI: HC$3.00/MF$0.65

Polarizations resulting from the elastic scattering of neutrons by complex nuclei were calculated for a number of nuclides at energies between 0 and 16 MeV. Comparison is made with experimental data where such are available. The elements and energies were selected on the basis of the AEC's Nuclear Cross Sections Advisory Group request compilation. Author (NSA)

N68-22571# Brookhaven National Lab., Upton, N. Y.

FORWARD DISPERSION RELATIONS: THEIR VALIDITY AND PREDICTIONS

S. J. Lindenbaum 29 Dec. 1967 64 p refs Presented at the Conf. on πN Scattering, Irvine, Calif., 1–2 Dec. 1967
(BNL-12058; CONF-671203-4) CFSTI: HC$3.00/MF$0.65

The discussion of forward dispersion relations includes meson (π)-nucleon elastic scattering, meson (π)-nucleon forward dispersion relations, asymptotic bounds on total cross sections, early applications of forward dispersion relations, experimental measurements of π–N forward scattering amplitude, and a comparison of experimental results with the predictions of the $\pi + N$ forward dispersion relations. Also considered are the fundamental length, charge independence, $p + p$ and $p \mp p$ forward scattering amplitudes and dispersion relations, and asymptotic theory. Author (NSA)

N68-22575# California Univ., Livermore. Lawrence Radiation Lab.

ON MODELS FOR CALCULATING EFFECTS OF THERMAL MODERATOR MOTION

Eugene Canfield 15 Jul. 1967 23 p refs
(UCRL-50323) CFSTI: HC$3.00/MF$0.65

Formulas are derived for the Doppler-broadened effective cross sections for arbitrary forms of the cold nuclear cross section for two models (a Maxwell gas, and a single-speed model where each atom has energy 3/2 kT). For some simple smooth cross sections, the model results are in excellent agreement for energies and temperatures typical of reactor calculations and even up to regions appropriate to nuclear explosions and stellar interiors, but diverge for very subthermal neutrons. The area under a resonance is found to be temperature-dependent (contrary to common belief). Again the models are in good agreement at ordinary temperatures, but the agreement is only qualitative at very high temperatures. The problem of choosing a target-atom velocity (before collision) for Monte Carlo calculations of the subsequent kinematics is discussed. A formal method of choosing the velocity is shown, but it appears impractically slow and tedious for Monte Carlo calculations. Author (NSA)

N68-22581# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

ELECTROMAGNETIC INTERACTIONS

H. Joos Nov. 1967 41 p refs Presented at the Intern. Conf. on Elementary Particles, Heidelberg, 20–27 Sep. 1967
(DESY-67/43)

A review of the theoretical aspects of electromagnetic interactions is presented. The topics covered are the general properties of the electromagnetic current operator, the meson (π) form factor, leptonic decays of vector mesons, photoproduction of vector mesons, multipion photoproduction, the photoproduction of mesons (π) at low and medium energies, and electromagnetic coupling constants and radiative decays. NSA

N68-22582# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.

GAKIN: A ONE DIMENSIONAL MULTIGROUP KINETICS CODE

K. F. Hansen and S. R. Johnson 24 Aug. 1967 123 p refs
(Contract AT(04-3)-167)
(GA-7543) CFSTI: HC$3.00/MF$0.65

The computer program GAKIN is described as it existed on August 24, 1967. The multigroup equations are given, and the numerical algorithm is described together with some of the techniques used in the solutions. A sample problem is included as is a listing of the program. NSA

N68-22583# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.

THE ACCELERATION OF THE HE 3 IONS IN THE U-120 CYCLOTRON

T. Fukatko, A. Hrda, O. Karban, M. Krivanek, and K. Kult Sep. 1967 8 p
(UJV-1898)

By modification of magnetic field gradient in the cyclotron U-120 the conditions were established which allowed the acceleration of $^3He^+$ ions. The estimated energy of external beam was (21.4±0.15) MeV. Since the particles of energy about 32 MeV could not be extracted from the accelerating chamber of the cyclotron they were used for obtaining isotopes of Pt. Author (NSA)

N68-22588# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

N-FORBIDDEN β-TRANSITIONS IN ODD-MASS NUCLEI IN THE APPROXIMATION OF THE FINITE DIFFUSED POTENTIAL [N-ZAPRESHCHENNYE β-PEREKHODY V DEFORMIROVANNYKH YADRAKH V PRIBLIZHENII KONECHNOGO POTENTSIALA S RAZMYTYM KRAEM]

F. A. Gareev, B. N. Kalinkin, N. I. Pyatov, and M. I. Chernei 1967 17 p refs In RUSSIAN
(JINR-P4-3650)

N-forbidden β transitions in odd-mass rare-earth nuclei were considered. The single-particle wave functions of the Woods–Saxon's potential including $N \pm 2$ shell states admixtures were used in calculations. The pairing correlation effects were taken into account. The finite log-ft values are obtained for such transitions while the Nilsson model predicts the zero transition probability. The calculated log-ft values satisfactorily fit the experimental data. Author (NSA)

N68-22590*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

CALCULATED COLLISION INDUCED ABSORPTION SPECTRUM FOR HE–AR

D. A. McQuarrie and R. B. Bernstein 1 Mar. 1968 44 p refs
(Grant NsG-275-62)
(NASA-CR-94349; WIS-TCI-287) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Computations are presented for the translational absorption spectrum of a model system of dissimilar rare gas atoms chosen to simulate the He–Ar pair. The procedure takes proper account of the non-linear collision trajectories (evaluated on the basis of a realistic interaction potential derived from beam scattering experiments) and the theoretical form of the dipole moment function.

The calculations reproduce the experimental line shape for He–Ar fairly well, provided the "dipole range parameter" is altered by some 7% from its *ab initio* value. Author

N68-22592# Tubingen Univ. (West Germany).

REPORT ON INVESTIGATIONS ON THE CLUSTER MODEL OF THE ATOMIC NUCLEUS, 1965–1966 [UNTERSUCHUNGEN ZUM CLUSTERMODELL DES ATOMKERNS, JAHRESBERICHT 1965–1966]

Sep. 1967 71 p refs In GERMAN; ENGLISH summary

(BMwF-FBK-67-81)

Investigations in the framework of the cluster model of the atomic nucleus are reported. Mathematical aspects of refined cluster-model calculations; the structure of ^{3}H, ^{3}He, ^{4}He, ^{6}Li, ^{7}Li, ^{7}Be; reaction theory; electromagnetic transitions in ^{6}Li; the N–N soft-core central potential; the N–N spin-orbit potential; the influence of the Pauli principle on nuclei; ^{3}He–^{3}He scattering; isospin mixing in ^{8}Be; the energy width of virtual resonance levels; and asymmetric fission were studied. Author (NSA)

N68-22594# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

MOBILITY OF ELECTRONS AND IONS IN LIQUID HELIUM. SURVEY OF CURRENT LITERATURE [MOBILITE DES ELECTRONS ET DES IONS DANS L'HELIUM LIQUIDE. MISE AU POINT BIBLIOGRAPHIQUE]

Jean-Louis Schwob Oct. 1967 34 p refs In FRENCH

(CEA-Bib-101)

Recent experiments on charged-particle mobility in liquid helium ^{4}He confirm the quantum theory of superfluidity at very low temperatures. Results obtained in small electric fields are interpreted in terms of ion scattering by elementary excitations: rotons (between 2 and 0.6°K) and phonons (below 0.6°K), while ion motion in strong fields is explained by the creation of quantized vortex rings. The results also show the existence of a complex structure of ions in liquid helium. The different models proposed in the literature are discussed. A large number of recent experimental data seems to be satisfactorily explained by the "electrostriction model" for positive ions, in which an atom cluster is formed around He_2^+ and by the "bubble model" for negative ions which are assumed to be constituted of an electron trapped in a cavity. Author (NSA)

N68-22595# Tubingen Univ. (West Germany).

DYNAMICAL THEORY OF NUCLEAR REACTIONS IN THE FRAMEWORK OF THE CLUSTER MODEL [DYNAMISCHE THEORIE DER KERNREAKTIONEN IM RAHMEN DES CLUSTERMODELLS]

H. C. Benoehr Sep. 1967 122 p refs In GERMAN; ENGLISH summary

(BMwF-FBK-67-82)

A unified theory of nuclear structure and nuclear reactions is formulated in the framework of nonrelativistic quantum mechanics. The Pauli principle is included without any restrictions. Approximate solutions of the Schroedinger equation are constructed by means of the Rayleigh–Schroedinger variational principle and the use of properly chosen trial functions. From the ideas of the cluster model, a systematic procedure for the construction of trial functions is derived. A differentiation between direct processes and compound processes results from the theory in a quite natural way. The theory of compound resonances is discussed in detail for an isolated resonance. Author (NSA)

N68-22598# Brookhaven National Lab., Upton, N. Y.

ANNUAL REPORT, 1 JULY 1967

Nov. 1967 228 p refs

(Contract AT(30-2)-GEN-16)

(BNL-50057) CFSTI: HC$3.00/MF$0.65

Summary data are presented on various research activities in the areas of chemistry, instrumentation, applied mathematics and computer programming, biology, medical research, nuclear engineering, physics, and high energy accelerators. These include studies on: (1) high energy nuclear reactions and nuclear spectroscopy, (2) affects of ionizing radiation on living things, (3) reactor physics and reactor technology, (4) radiation detectors and related instruments, and (5) operation, maintenance, and exploitation of the Alternating Gradiant Synchroton. B.S.D.

N68-22602# Commissarait a l'Energie Atomique, Fontenay-aux-Roses (France).

DOSAGE OF CESIUM 137 IN RADIOACTIVE WASTES BY THE APPLICATION OF SODIUM TETRAPHENILBORATE [DOSAGE DU CESIUM 137 DANS LES EFFLUENTS RADIOACTIFS PAR LE TETRAPHENYLBORATE DE SODIUM]

Gilbert Testemale and Jacques Girault Dec. 1967 31 p refs In FRENCH

(CEA-R-3391) CFSTI: HC$3.00/MF$0.65

A simple technique for determining dosages of ^{137}Cs has been developed. The technique consists of the formation of cesium tetraphenyl borate, followed by a double extraction with isoamil acetate and washing of the organic phase. The counting of known parts of the cesium solution, assaying its purity by γ spectrometry, permits the determination of the ^{137}Cs. The yield is about 98 per cent. Author

N68-22604# Commissariat a l'Energie Atomique, Saclay (France).

STUDY OF VARIOUS PROCESSES FOR MARKING SEDIMENTS WITH GOLD-198 [ETUDE DE DIVERS PROCEDES DE MARQUAGES DE SEDIMENTS PAR L'OR 198]

Bernard Jeanneau Dec. 1967 164 p refs In FRENCH

(CEA-R-3389) CFSTI: HC$3.00/MF$0.65

Two methods using radioactive isotopes for the study of sediment deposits are discussed: (1) marking in the mass, in which a glass of an element that can be activated replaces the sediment; and (2) surface marking, in which a physico-chemical process is used to deposit a radioactive element at the surface of the sediment. The second process is used in particular for sands, when it is advantageous to have a large number of particles for statistical analysis. A rapid and simple method is described for marking on the site of the experiment where the use of equipment may be limited. K.W.

N68-22605# California Inst. of Tech., Pasadena.

ENERGY TRANSFER IN MOLECULAR COLLISIONS

Merle Eugene Riley (Ph.D. Thesis) 18 Dec. 1967 285 p refs

Supported in part by NSF

(Contract AT(04-3)-532)

(CALT-532-19) CFSTI: HC$3.00/MF$0.65

Two general, numerically exact, quantum mechanical methods have been developed for the calculation of energy transfer in molecular collisions. The methods do not treat electronic transitions because of the exchange symmetry of the electrons. All interactions between the atoms in the system are written as potential energies. The first method is a matrix generalization of the invariant imbedding procedure, adapted for multichannel collision processes. The second method is based on a direct integration of the matrix Schroedinger equation, with a reorthogonalization transform applied during the integration. Both methods have been applied to a collinear collision model for two diatoms, interacting via a repulsive exponential potential. Two major studies were performed. The first was to determine the energy dependence of the transition probabilities for an H_2 on H_2 model system. Transitions are possible between translational energy and vibrational energy, and from vibrational modes of one H_2 to the other H_2. The second study was to determine the variation of vibrational energy transfer probability with differences in natural frequency of two diatoms similar to N_2. Comparisons were made to previous approximate analytical solutions of this same problem. For translational-to-vibrational energy transfer, the previous approximations were not adequate. For vibrational-to-vibrational energy transfer of one vibrational quantum, the approximations were quite good. Author (NSA)

N68-22606# International Centre for Theoretical Physics, Trieste (Italy).

INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS ANNUAL REPORT, 1966–1967

Nov. 1967 58 p refs
(NP-17252)

A description is given of the activities of the International Centre for Theoretical Physics. The research carried out covers nuclear physics, field theory, the quark model, the N/D method, Regge pole theory, group theory, and superconvergence and current algebra. Other activities include training programs, the fostering of physics in developing countries, and a theoretical physicists forum. NSA

N68-22615# California Univ., Berkeley. Lawrence Radiation Lab.

QUASI-ELASTIC STOPPING CROSS-SECTION FOR VERY LOW ENERGY IONS

Cao-Xuan-Chuan 7 Aug. 1967 15 p refs Presented at the Meeting of the Am. Phys. Soc., Pasadena, Calif.
(Contract W-7405-ENG-48)
(UCRL-17717; CONF-671202-1) CFSTI: HC$3.00/MF$0.65

The energy loss by quasi-elastic stopping of very-low-energy ions passing through matter is discussed and the concept of close and distant collisions is introduced. The expression of the stopping cross sections is derived and agrees well with the results of previous authors as far as the nuclear effect is concerned. However, the agreement is only partial for the electronic effect. Author (NSA)

N68-22617# Lyon Univ. (France).

THEORETICAL STUDY OF PION ANGULAR DISTRIBUTIONS IN PROTON–ANTIPROTON ANNIHILATIONS UP TO FOUR PIONS. 1: BY THE CONVENTIONAL LAGRANGIAN FIELD THEORY

R. Laverriere and J. Proriol 10 Jul. 1967 36 p refs
(LYCEN-6757)

An extensive study of proton–antiproton annihilations into mesons is made by consideration of Feynman graphs. The aim is to derive all possible information in that scheme mainly about angular distributions. Numerical applications are made for 1.61-, 3.25-, and 5.70-GeV/c incident laboratory antiproton momenta. The conclusions are that there is a qualitative agreement concerning the angular distributions but often serious failures concerning the cross sections. These conclusions emphasize the legitimacy of building phenomenological models to study such elementary particle processes. Such a model is presented. Author (NSA)

N68-22626# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

EVALUATED CROSS SECTIONS FOR THE HAFNIUM ISOTOPES

J. T. Reynolds, C. R. Lubitz, I. Itkin (Bettis Atomic Power Lab., Pittsburgh), and D. R. Harris (Bettis Atomic Power Lab., Pittsburgh) 17 Aug. 1967 22 p refs
(Contract W-31-109-ENG-52)
(KAPL-3327) CFSTI: HC$3.00/MF$0.65

Evaluated libraries of cross sections were prepared for natural hafnium and its isotopes ^{174}Hf, ^{176}Hf, ^{177}Hf, ^{178}Hf, ^{179}Hf, and ^{180}Hf. The libraries contain total, elastic, capture, inelastic, (n,p), and (n,2n) cross sections and elastic scattering Legendre moments below 15 MeV. The most recent experimental data were used in the evaluation; and, whenever data were not available, theoretical calculations were made. Author (NSA)

N68-22629# Lyon Univ. (France).

THEORETICAL STUDY OF PION ANGULAR DISTRIBUTIONS IN PROTON–ANTIPROTON ANNIHILATIONS UP TO FOUR IONS. 2: BY A SIMPLE MODEL

R. Laverriere and J. Proriol 10 Jul. 1967 52 p refs
(LYCEN-6751)

To study the pion angular distribution in proton–antiproton annihilations, a simple model starting from the model of Koba and Takeda is presented: the nucleons are assumed to be formed by a core and a pion cloud and final pions can be produced by core annihilation and cloud emission. A detailed kinematical study of all the possible annihilation reactions is made with very simplified assumptions for the physical processes. Resonance production is considered. Numerical calculations are made for 1.61-, 3.25-, and 5.70-GeV incident laboratory antiproton momenta. When a comparison with the experimental data is possible, very good agreement is found for the angular distributions and assymetry coefficients. Author (NSA)

N68-22631# California Univ., Berkeley. Lawrence Radiation Lab.

THE MOLECULAR-BEAM ELECTRIC RESONANCE SPECTRA OF NaCl AND NaBr

C. A. Melendres, A. J. Hebert, and K. Street, Jr. Nov. 1967 45 p refs
(Contract W-7405-ENG-48)
(UCRL-17916) CFSTI: HC$3.00/MF$0.65

The radiofrequency Stark spectra of ^{23}Na^{35}Cl, ^{23}Na^{37}Cl, ^{23}Na^{79}Br, and ^{23}Na^{81}Br were observed by the molecular-beam electric resonance method of molecular spectroscopy. Analysis of spectral lines obtained by observing transitions of the type $J = 1, M_J = \pm 1 \rightarrow J = 1\ M_J = 0$ at strong electric fields yielded molecular dipole moments and nuclear hyperfine interaction constants for the different vibrational states of the molecules. Author (NSA)

N68-22639# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

RESONANCES (BUBBLE CHAMBER)

E. Lohrmann Nov. 1967 73 p refs Presented at Intern. Symp. on Electron and Photon Interactions at High Energies, Stanford, Calif., 1967
(DESY-67/40)

An account of photoproduction of mesonic and baryonic resonances on protons and neutrons observed in bubble chambers is given. The energies covered the range from threshold to about 6 GeV. The production of various meson and nucleon resonances is considered, and the cross sections are shown. NSA

N68-22640# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

HYDROGEN CONDENSATION TARGET [WASSERSTOFF-KONDENSATIONS-TARGET]

Godehardt Kessler Nov. 1967 17 p ref In GERMAN; ENGLISH summary
(DESY-67/44)

A hydrogen–deuterium target is described, which reduces the safety problems connected with the handling of liquid hydrogen targets, without the liquid hydrogen being given up as the main cryogenic fluid. Author (NSA)

N68-22646# Brookhaven National Lab., Upton, N. Y.

CROSS SECTIONS AND RESONANCE CAPTURE AND FISSION INTEGRALS OF LONG LIVED AMERICIUM ISOTOPES

M. A. Bak, A. S. Krivokhatskii, K. A. Petrzhak, Yu. G. Petrov, Yu. F. Romanov et al 1967 12 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 23, 1967 p 316–319
(BNL-TR-175) CFSTI: HC$3.00/MF$0.65

Samples of pure ^{241}Am and of a mixture of ^{241}Am and ^{243}Am were irradiated in the VVR-M reactor; and the formation of ^{242}Am, ^{242m}Am, and ^{244}Am was studied. Cadmium ratios were determined, and the α activity of the products formed was measured using silicon detectors. Values for the neutron capture and fission cross sections and resonance integrals of ^{241}Am, the fission cross section and resonance integral of ^{242}Am, and the capture cross section and resonance integral of ^{243}Am were obtained. NSA

N68-22648# General Dynamics Corp., San Diego, Calif. General Atomic Div.

NEUTRON CROSS SECTIONS FOR NIOBIUM

M. S. Allen and M. K. Drake 2 Aug. 1967 71 p refs
(Contract AT(04-3)-167)
(GA-8133) CFSTI: HC$3.00/MF$0.65

The neutron cross sections for Nb that were prepared for the Evaluated Nuclear Data File are described. The cross sections were prepared from sets of previously evaluated data and from data that were obtained in an attempt to complete the existing data. NSA

N68-22658# Oak Ridge National Lab., Tenn.

PION–NUCLEON DIFFERENTIAL CROSS SECTIONS IN THE 0 TO 700-MEV ENERGY REGION IN TERMS OF THE COULOMB SCATTERING AMPLITUDE, COULOMB PHASE SHIFTS, AND NUCLEAR PHASE SHIFTS UP TO L = 4

Hugo W. Bertini Jan. 1968 25 p refs
(Contract W-7405-ENG-26)
(ORNL-4197) CFSTI: HC$3.00/MF$0.65

A derivation of the expression for the pion–nucleon differential scattering cross section in terms of the nuclear phase shifts is presented. It follows that of Ashkin. The method for altering this expression in order to obtain the cross section for all charge states of the pion and nucleon is described where simple isotopic spin analysis is employed. Coulomb and absorption effects are incorporated in the manner described by Roper, Wright, and Feld. A detailed and lengthy equation for the cross section in terms of the electromagnetic amplitudes, Coulomb phase shifts, and nuclear partial-wave amplitudes is presented where the multiplication of the usual series expansion for the cross section was carried out for terms up to $l = 4$. Instructions are given for the substitution of appropriate expressions into the equation for the cross section so that it will apply to each charge state of the pion and nucleon. These expressions are functions of the nuclear phase shifts, the Coulomb phase shifts, and the absorption parameters. A table of the phase shifts and absorption parameters published by Roper et al. is included. The work described is utilized in an intranuclear cascade calculation for interactions up to about 3 GeV. Author (NSA)

N68-22660# California Univ., Berkeley. Lawrence Radiation Lab.

RESONANCE PRODUCTION, PARTICULARLY Y_1^* (1385) AND ρ, IN $K^-p \rightarrow \Lambda\pi^+\pi^0\pi^-$ AND $K^-p \rightarrow \Lambda\pi^+\pi^-$; p_{K^-} = 2.1–2.7 GEV/C

Daniel M. Siegel (Ph.D. Thesis) 26 Dec. 1967 119 p refs
(Contract W-7405-ENG-48)
(UCRL-18041) CFSTI: HC$3.00/MF$0.65

Some 20,000 $K^-p \rightarrow \Lambda\pi^+\pi^0\pi^-$ and 10,000 $K^-p \rightarrow \Lambda\pi^+\pi^-$ events are identified in the 72-inch hydrogen bubble chamber. Analysis of these reactions, by means of maximum likelihood fits to comprehensive models involving known resonances, yields cross sections and production angular distributions for quasi-two-body states $Y_1^*(1385)^{\pm}_{0}\rho^{0}$, $Y_1^*(1385)^{\mp}\pi^{\pm}$, and $\Lambda^0\rho^0$. Analysis of decay angular distributions for peripheral reactions indicates predominance of K meson exchange for $K^-p \rightarrow Y_1^*(1385)^+\rho^-$, and K^* exchange for $K^-p \rightarrow Y_1^*(1385)^+\pi^-$. Author (NSA)

N68-22663# California Univ., Livermore. Lawrence Radiation Lab.

THE REINFORCING EFFECT OF IRRADIATION ON THE LUMINESCENCE OF (ZN, CD)S: MN EXCITED BY α RAYS; STUDY OF THE INDIVIDUAL SCINTILLATIONS

A. Geoffroy Jul. 1966 9 p refs Transl. into ENGLISH from Comp. Rend. (Paris), v. 261, 1965 p 5072–5075
(UCRL-TRANS-10205) CFSTI: HC$3.00/MF$0.65

The present article is concerned with the reinforcing action of irradiation on the total luminous emission and on the individual scintillations in (Zn,Cd)S:Mn excited by the α rays of ^{210}Po. Author (NSA)

N68-22664# Lyon Univ. (France).

EULER ANGLES FOR THREE AND FOUR IDENTICAL PARTICLE SYSTEMS. 3: HELICITY FORMALISM

R. Laverriere and J. Proriol 18 May 1967 6 p refs
(LYCEN-6734)

A method to introduce permutation properties in the helicity eigenfunctions for three and four identical particle systems is presented. Author (NSA)

N68-22665# Los Alamos Scientific Lab., N. Mex.

ENERGY PENETRATION INTO HARMONIC AND ANHARMONIC DISORDERED LATTICES

Daniel Payton, III, Marvin Rich, and William M. Visscher Oct. 1967 21 p refs
(Contract W-7405-ENG-36)
(LA-3626) CFSTI: HC$3.00/MF$0.65

A discussion is given of a computer-generated film which gives a direct graphical representation of penetration of an energy wave into two-dimensional isotopically disordered lattices. The blockage of energy flow due to low concentrations of light impurities in a host lattice is contrasted with that due to like arrangements of heavy impurities. Similarly, the differences between energy flow into harmonic and anharmonic lattices are considered. The film demonstrates that energy flows more easily through a disordered anharmonic lattice than through an equivalent harmonic lattices and that it is less impeded by light impurities than by heavy ones. Author (NSA)

N68-22666# Stanford Univ., Calif. Linear Accelerator Center.

PHOTOPRODUCTION OF POSITIVE π MESONS BETWEEN 1.2 AND 3 GEV IN THE CENTER OF MASS ANGLES REGION FROM 2.5° TO 15° [PHOTOPRODUKTION VON POSITIVEN PI-MESONEN ZWISCHEN 1.2 UND 3 GEV IM SCHWERPUKTSWINKELBEREICH VON 2.5°–15°]

U. Koetz Mar. 1967 57 p refs Transl. into ENGLISH from German
(NP-16737; SLAC-TRANS-69) CFSTI: HC$3.00/MF$0.65

The reaction $\gamma p \rightarrow \pi^+ n$ was investigated for photon energies between 1.2 and 3 GeV and pion center-of-mass angles from 2.5 to 15°. In the energy region of the nucleon isobars $N_{3/2}$ (1920) and $N_{1/2}$ (2190) the differential cross section shows resonance structure which becomes more pronounced with decreasing production angle. The observed forward peaking in all angular distributions is in disagreement with simple one-pion exchange models. Models which take into account the interference between the one-pion exchange and the nucleon pole (s-channel) graph and also final-state absorption are in qualitative agreement with the experimental results only at small angles and low energies. Author (NSA)

N68-22670# Los Alamos Scientific Lab., N. Mex.

MEASUREMENT OF THE QUALITY FACTOR FOR HIGH ENERGY NEUTRONS IN A TISSUE EQUIVALENT PHANTOM [IZMERENIE FAKTORA KACHESTVA NEITRONOV VYSOKIKH ENERGII V TKANEEKVIVALENTNOMI FANTOME]

M. Zel'chinskii, M. M. Komochkov, B. S. Svchev, and A. P. Cherevatenko 1967 7 p refs Transl. into ENGLISH from Russian Rept. JINR-P16-3587
(LA-TR-68-8; JINR-P16-3587)

Distribution of the dose rate and the quality factor in the tissue-equivalent phantom, bombarded with the neutron beam with a maximum energy of 700 MeV, is investigated. The measurements were performed by using a recombination ionization chamber. By comparing the value of the dose rate at the depth of 2.5 cm and that of the neutron flux ($E < 20$ MeV) the ratio $(8.6 \pm 2.1)\ 10^{-9}$ rad/neutr. cm^{-2} is obtained. Author (NSA)

N68-22671# Brookhaven National Lab., Upton, N. Y.

INCOHERENT SCATTERING OF SLOW NEUTRONS IN POLARIZED TARGET [NEKOGERENTNOE RASSEYANIE MEDLENNYKH NEITRONOV V POLYARIZOVANNOI MISHENI]

V. G. Baryshevskii, V. L. Lyuboshits, and M. I. Podgoretskii 1967 8 p refs Transl. into ENGLISH from Russian Rept. JINR-P4-3158)
(BNL-TR-139; JINR-P4-3158)

Transmission of polarized slow neutrons through a polarized crystal target is considered. It is shown that incoherent neutron scattering in such a model is due not only to the scattering with spin flip but also to the presence of fluctuations of a magnetic quantum nucleus number. The relative deposit of these processes depends on the angles between the direction of neutron polarization and that characterizing the polarization target state. Author (NSA)

N68-22672# Stanford Univ., Calif. Linear Accelerator Center.

INVESTIGATION OF (E^+E^-) PAIR PRODUCTION BY ELECTRONS WITH ENERGY OF 2.4 GEV [ISSLEDOVANIE OBRAZOVANIYA (E^+E^-) PAR ELEKTRONAMI S ENERGIEI 2.4 GEV]

Ya Bem, V. G. Grishin, M. M. Muminov, and V. D. Ryabtsov 1967 26 p refs Transl. into ENGLISH from Rept. No. JINR-P1-3143
(SLAC-TRANS-64; JINR-P1-3143) CFSTI: HC$3.00/MF$0.65

Direct production of (e^+e^-)-pairs with $E\gamma \geq 10$ MeV by 1.25–4 GeV electrons was investigated with the help of a 24-liter propane bubble chamber. The obtained cross section $\sigma_{tr} = 55 \pm 24$ mb is in agreement with the theoretical value obtained by Bhabha. The method proposed admits a successful measuring of the σ_{tr} by means of a hydrogen bubble chamber. Author (NSA)

N68-22675# Kentucky Univ., Lexington. Dept. of Electrical Engineering.

DIELECTRIC RELAXATION IN THE MIXTURES: BENZONITRILE + PROPIONITRILE, BENZONITRILE + ACETONITRILE AND IN ANILINE AND ANISOLE

T. J. Bhattacharyya, T. V. Gopalan, and P. K. Kadaba 13 Dec. 1967 9 p refs
(Contract AT(40-1)-2840)
(ORO-2840-5; CONF-670957-1) CFSTI: HC$3.00/MF$0.65

Dielectric relaxation of mixtures of polar molecules has not been studied extensively in contrast with solutions of polar molecules in nonpolar solvents and pure polar liquids. The initial studies on dipolar mixtures involved relatively complex nonrigid molecules, the interpretation of the behavior of which as mixtures in any detail is vitiated by the complexity. Schallamach in his study of the temperature dependence at low temperatures of the order of −100°C and at a single radio frequency on mixtures of complex molecules, has come to the conclusion that the dielectric relaxation in mixtures involves the distrubance of relatively large regions in the liquid so much so the individuality of the two members is not significant. Studies on a single mixture of alkyl halides at temperatures close to the melting points of the individual components by Denney in the audio and radio-frequency regions seem to support Schallamach's conclusion. The investigation on mixtures of certain nitriles is a continuation of a study on mixtures of simple rigid polar molecules at microwave frequencies near room temperature. Author (NSA)

N68-22677# Argonne National Lab., Ill.

LOCAL MODES IN LI–MG AND BE–CU ALLOYS [LOKAL'NYE KOLEBANIYA V SPLAVAKH LI–MG I BE–CU]

I. Natkanets, K. Parlin'ski, A. Baiorek, and M. Sudnikkhrynkevich 1967 6 p refs Transl. into ENGLISH from Russian Rept. JINR-P3-3216
(ANL-TRANS-474; JINR-P3-3216) CFSTI: HC$3.00/MF$0.65

Inelastic neutron scattering experiments with the alloys $Li_{0.05}$–$Mg_{0.95}$, $Li_{0.10}$–$Mg_{0.90}$, $Be_{0.02}$–$Cu_{0.98}$, and $Be_{0.05}$–$Cu_{0.95}$ and the pure metals, Mg and Cu, revealed of the impurity Li atoms in the Mg lattice of an energy of (35 ± 2) MeV and the Be atoms in the Cu lattice of an energy of (42 ± 2) MeV. The energy of these local modes for these systems, calculated with the assumption that the force constants in the vicnity of the impurity atom remain unchanged, equals 43 MeV (Li–Mg) and approximately 58 MeV (Be–Cu), respectively. It was estimated on the basis of the measured energies of local modes that the average change of the force constants of the impurity atom is approximately 45% for Li–Mg and 56% for Be–Cu. Author (NSA)

N68-22686*# Ohio State Univ., Columbus. Electroscience Lab.

FORMATION OF IONIZED EXCITED STATES FROM THE LOSS OF THE METASTABLE ELECTRON IN THE NOBLE GAS ATOMS

S. H. Koozekanani 19 Apr. 1968 12 p refs
(Grant NsG-74-60)
(NASA-CR-94388; TR-1093-39) CFSTI: HC $3.00/MF $0.65 CSCL 20H

It is shown that when the metastable electron of a noble gas atom is removed by a fast collision it is quite possible for the atom to be ionized and excited at the same time. Excitation cross sections for these processes have been calculated in terms of the cross sections for removing the electrons. Author

N68-22690# General Dynamics Corp., San Diego, Calif. General Atomic Div.

LATTICE PHYSICS STUDIES Quarterly Progress Report, Period Ending Sep. 30, 1967

G. D. Trimble, T. Gozani, P. d'Oultremont, and C. A. Preskitt 10 Oct. 1967 52 p refs
(Contract AT(04-3)-167)
(GA-8304; EURAEC-1948; QPR-6) CFSTI: HC$3.00/MF$0.65

Measurements of angular thermal neutron spectra are discussed; results are given. Neutron die-away and mean emission times were measured in several energy domains. Measurement techniques and equipment are described. NSA

N68-22691# Maryland Univ., College Park. Dept. of Physics and Astronomy.

LORENTZ TRANSFORMATION OF PROBABILITY DENSITIES

Robert E. Knop Sep. 1967 21 p refs
(Contract AT(40-1)-2504)
(ORO-2504-111; TR-731) CFSTI: HC$3.00/MF$0.65

The problem of the Lorentz transformation of a probability density to the laboratory frame from the center of momentum frame of a particle decaying isotropically into solid angle is reviewed. A Fortran program which was written to perform such transformations together with averaging over another density such as the density of momentum of the decaying particle at production or the density of elapsed proper time since production is described. Selected transformations performed for decaying hyperons produced by stopped K^- in hydrogen are presented. NSA

N68-22692# Purdue Univ., Lafayette, Ind. Dept. of Physics.

COBALTOUS OXIDE. 1. A COMPACT SINGLE LINE SOURCE

James G. Mullen and Hang Nam Ok [1967] 13 p refs
Presented at 4th Moessbauer Symp., Chicago
(Contract AT(11-1)-1616)
(COO-1616-7; CONF-680107-1) CFSTI: HC $3.00/MF $0.65

Methods for preparing stoichiometric cobaltous oxide are discussed. Moessbauer patterns for CoO prepared 3 different ways are considered and the Debye temperature measured. Variations in structure of the products from the 3 methods of preparation are described. It may be possible to fabricate ^{57}CoO sources of 1 to 10 Ci activity without any appreciable electronic absorption. NSA

N68-22694# Hawaii Univ., Honolulu.

RESONANCE PRODUCTION IN THE INTERACTION $\pi^- + p \rightarrow p + \pi^+ + \pi^-$ AT 3.9 GEV/C

Peter G. Wohlmut (M.S. Thesis) Jan. 1968 53 p refs
(Contract AT(04-3)-511)
(UH-511-17) CFSTI: HC $3.00/MF $0.65

A study has been made of the nonstrange, charged four-body final state π^-+ proton interactions at 3.9 GeV/c incident momentum. It was found that resonance production dominates at this momentum, and that the data are consistent with a pure resonance model with kinematic phase space background. Significant fractions of single resonance production of ρ^0, $\Delta^{2+}(1236)$, $\Delta^0(1236)$, and the cascade resonances $A^-_1 \rightarrow \rho^0 + \pi^-$, $A^-_2 \rightarrow \rho^0 + \pi^-$, $N^{*+}(1450) \rightarrow \Delta^{2+}(1236) + \pi^-$, $N^{*+}(2650) \rightarrow \Delta^{2+}(1236) + \pi^-$ are essential for a good fit. Evidence is presented for the decay $\pi^-(1620) \rightarrow f^0(1250) + \pi^-$ and for an $I = 3/2$ state in the $p\pi^-\pi^-$ system at 2650 MeV. Total cross sections are determined for each of the processes necessary for the fit to the data, and recommendations are made in regard to enlarging the resonance model to include both kinematic and dynamic effects. Author (NSA)

N68-22698# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

REDUCED CLUSTER WIDTHS FOR ^{14}N AND ^{15}N [KLASTERNYE PRIVEDENNYE SHIRINY DLYA ^{14}N I ^{15}N]

M. A. Zhusupov, O. Lkhagva, and I. Rotter 1968 11 p refs In RUSSIAN
(JINR-P4-3681)

Reduced triton and α widths for the low-lying levels of ^{14}N and ^{15}N having the configurations $(1p)^{-n-2}(2s,1d)^n$, and $(1p)^{-n-1}(2s,1d)^n$, respectively, are calculated. These cluster widths are compared with those of lighter nuclei having the pure configuration $(1p)^n$. The mechanism of reactions of the type (^{6}Li,d) on light nuclei at low energies is discussed. Author (NSA)

N68-22712# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

NEW ISOMETRIC STATES BY THE DECAY OF SHORT-LIVED ISOTOPES OF ^{140}Sm ^{141}Sm, ^{140}Pm; ON THE DECAY OF ^{142}Pm [NOVYE IZOMERNYE SOSTOYANIYA PRI RASPADE KOROTKOZHIVYSHCHIKH IZOTOPOV ^{140}Sm, ^{141}Sm, ^{140}Pm O RASPADE IZOTOPA ^{142}Pm]

R. Arl't, B. Baier, G. Muziol, L. K. Peker, G. Pfrerer et al 1967 21 p refs In RUSSIAN
(JINR-P6-3540)

Positron emission from the decay of ^{140}Sm and γ spectra from the ^{140}Sm and ^{141}Sm decays were measured. Data on the existence of two new isomeric states in the ^{140}Pm and ^{141}Sm nuclei are given. Author (NSA)

N68-22713# Joint Inst. for Nuclear Research, Dubna (USSR).

INVESTIGATION OF SHORT-LIVED NUCLEAR SYSTEM PROPERTIES [ISSLEDOVANIE SVOISTV KOROTKOZHIVYSHCHIKH YADERNYKH SOSTAVNYKH SISTEM]

E. Lozhinski and I. I. Chuburkova 1967 11 p refs In RUSSIAN
(JINR-P7-3630)

The decay of the compound system of [^{197}Au + ^{40}Ar] nuclei in ≈10-particle transfer reactions was investigated. To study the angular distributions, a method of assembled foils was used. The angular distributions of the reactions ^{197}Au(^{40}Ar, ^{47}Sc)^{190}Os and ^{197}Au(^{40}Ar, ^{28}Mg)^{209}At for the energies (cms) ≈155, 170, and 195 MeV were investigated. The total cross sections and the upper limits of the cross sections of a number of reactions, in which about 16 particles are transferred, are given. Author (NSA)

N68-22716# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

NEW DATA ON THE DECAY SCHEME OF ^{159}ER [NOVYE DANNYE O SKHEME RASPADA ^{159}ER]

A. A. Abdurazakov, V. G. Kalinnikov, Zh. T. Zhelev, U. K. Nazarov, and Ya. Urbanets 1968 12 p In RUSSIAN
(JINR-P6-3660)

The γ-ray spectra and conversion-electron spectra of ^{159}Er were investigated. New γ transitions with the energies 582, 608, 649, and 837 keV were observed. The half-life of ^{159}Er was measured to be 37±2 min. The multipolarities of γ transitions were determined. New energy levels of 624.4 keV ($5/2^-$, [523]) and 649.5 ($5/2^+$, [413]) are suggested. The level scheme of the ^{159}Ho is discussed. Author (NSA)

N68-22722# California Univ., Berkeley. Lawrence Radiation Lab.

HYPERFINE STRUCTURE OF ^{165}DY AND SPIN OF ^{163}ER

Sanford Stein (Ph.D. Thesis) 15 Dec. 1967 69 p refs
(Contract W-7405-ENG-48)
(UCRL-17969) CFSTI: HC $3.00/MF $0.65

The atomic-beam magnetic-resonance flop-in method was used to measure the hyperfine structure of ^{165}Dy and the spin of ^{163}Er. The results for the ^{165}Dy ground state are $a = \pm 89.8(7)$ MHz and $b = \pm 1520(30)$ MHz, where a and b are the magnetic dipole and electric quadrupole hyperfine interaction constants. The spin was previously measured to be $I = 7/2$. From these values one can calculate the nuclear magnetic dipole moment μ_1 and the nuclear electric quadrupole moment Q which are μ_1 (uncorr) = ±0.50(4) nm and Q(uncorr) = ±2.8(3) barns. These values are in good agreement with that predicted by the strong deformation collective model. The spin of the ground state of ^{163}Er is $I = 5/2$ which agrees with the Nilsson state assignment. The theory underlying the atomic-beam method, a description of the technique and equipment used, and a comparison with appropriate theoretical calculations are presented. Author (NSA)

N68-22729# Argonne National Lab., Ill.

TABLES FOR THE CALCULATION OF MATRIX ELEMENTS OF OPERATORS OF ATOMIC QUANTITIES

R. I. Karaziya, Ya. I. Vizbaraite, Z. B. Rudzikas, and A. P. Yutsis 1967 131 p refs Transl. into ENGLISH from Tablitsy Dlya Rascheta Matrichnykh Elementov Operatorov Atomnykh Velichin (Moscow), 1967
(ANL-TRANS-563) CFSTI: HC $3.00/MF $0.65

Tables are given of fractional parentage coefficients and of submatrix elements U^k and V^{kl} ($k = 1, 2, ..., 2l$ and l is the orbital quantum number). They cover all p, d, and f electrons up to 4 electrons. The tables are given for partially filled shells. NSA

N68-22734# Maryland Univ., College Park. Dept. of Physics and Astronomy.

MEASUREMENTS OF K_2^0-P TOTAL CROSS SECTIONS AT LOW ENERGIES

Gustav Andrew Sayer (Ph.D. Thesis) Dec. 1967 107 p refs
(Contract AT(40-1)-2504)
(TR-748; ORO-2504-117) CFSTI: HC$3.00/MF$0.65

The total cross sections of K_2^0's on protons are measured in the momentum range 168–343 MeV/c. The results are analyzed in terms of the zero-effective range theory of Dalitz and Tuan. An independent determination of the T = 1 K–N scattering length is made. This is then compared with the scattering length of K^-–p experiments. Author (NSA)

N68-22738# Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire.

MEASUREMENT OF LONGITUDINAL PHOTON CONTRIBUTION IN PION ELECTROPRODUCTION FROM PROTONS

C. Betourne, C. Feautrier, J. Perez-Y-Jorba, and D. Treille Dec. 1967 27 p refs
(LAL-1185)

A measurement of the pion electroproduction cross section from protons, at a transfer $q^2 = -3.4\ f^{-2}$ and a πN mass of 1136 MeV, gave the values $\sigma_L = 27.0 \pm 9.2$ μb, $\sigma_T = 81.8 \pm 4.3$ μb, and $\omega_L/\sigma_T = .33 \pm .13$. It is shown that this result is very sensitive to a correct application of radiative corrections but rather insensitive to the exact analytic expressions used. Author (NSA)

N68-22741# Princeton-Pennsylvania Accelerator, Princeton, N. J.

AN EXPERIMENTAL STUDY OF NEGATIVE PION NUCLEUS SCATTERING FROM 0.6 TO 1.6 GEV

Edward S. Miller (Ph.D. Thesis) 11 Sep. 1967 137 p refs
(Contract AT(30-1)-2137)
(PPAD-630F) CFSTI: HC$3.00/MF$0.65

Meson (π^-)-nucleus absorption and diffraction cross sections were measured at a series of meson (π^-) energies from 600 to 1600 MeV for a dozen nuclei spanning a range in mass from Be to Au. These cross sections were analyzed in terms of an optical potential model of elastic scattering, yielding information on the magnitude of the real and imaginary parts of the potential and also a measure of the size of the interaction region. For the energy region covered, it was shown possible to relate directly the strength of the optical potential to the free two-body π N interactions. These calculations were refined to include second-order effects, the most important of which are multiple scattering corrections which involve nucleon–nucleon coorelations within the nucleus. NSA

N68-22743# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

NUMERICAL CALCULATION OF NUCLEAR SLATER INTEGRALS

J. Nachamkin Mar. 1968 12 p refs
(AECL-3041) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

A simple method is used to reduce the domain of integrations needed for the evaluation of Slater integrals. In effect, the two dimensional integrals over a large square are reduced to quadrature on a narrow strip along a diagonal of the square for the most common local two body forces. The time saved using this method is quite considerable for short-ranged potentials. Using an unrealistically short ranged Gaussian two body potential an accuracy of 3% or better was obtained in every case. Author

N68-22749# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

MAGNETIC MOMENTS OF THE COLLECTIVE STATES OF EVEN-EVEN SPHERICAL NUCLEI [MAGNITNVE MOMENTY KOLLEKTIVNYKH SOSTOYANII CHETNO-CHETNYKH SFERICHESKIKH YADER]

E. B. Bal'butsev and R. V. Dzholos 1967 13 p refs In RUSSIAN
(JINR-P4-3611)

Magnetic moments of the first 2^+ states of even Ru, Pd, Cd, and Te isotopes are analyzed on the basis of a model that takes into account pairing and quadrupole forces. It is shown that the theoretical results can agree with the experimental data. It means that the wave functions of the first 2^+ states are determined, on the whole, by collective quadrupole motion in the nucleus. Author (NSA)

N68-22764# Commissariat a l'Energie Atomique, Saclay (France).

MEASUREMENT OF $\pi \pm$ p FORWARD ELASTIC DIFFERENTIAL CROSS-SECTIONS AT 410 AND 490 MEV [MESURES DES SECTIONS EFFICACES DIFFERENTIELLES $\pi \pm$ p A 410 MEV ET 490 MEV VERS L'AVANT]

Marcel Banner (Ph.D. Thesis—Paris Univ.) 1967 55 p refs In FRENCH
(CEA-R-3146) CFSTI: HC$3.00/MF$0.65

Measurement of the $\pi \pm p$ forward elastic differential cross sections were performed with a missing mass spectrometer using spark chambers. Photographs were automatically scanned. Phase shift analysis of experimental results leads to three solutions. Experiments are indicated which ought to permit overcoming ambiguity. Author

N68-22785# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.

PARTICLE IN NUCLEAR COULOMB FIELD (SPECTRAL PROBLEMS)

Yu. L. Mentkovskii 1967 104 p refs
(ITF-67-15)

An analytic approach to the theory of charged-particle motion in Coulomb fields is presented in which the problems concerning the energy spectrum, the completeness of the set of physical solutions to the Schroedinger equation, and other spectral problems are solved on the basis of the theory of functions of a complex variable. NSA

N68-22786# Kentucky Research Foundation, Lexington.

ROTATION AND DEBYE RELAXATION SPECTRA OF DIPOLAR COMPOUNDS IN THE MICROWAVE REGION

Final Report, 1 Mar. 1961–31 Oct. 1967

Prasad K. Kadaba 13 Dec. 1967 26 p refs
(Contract AT(40-1)-2840)
(ORO-2840-4) CFSTI: HC$3.00/MF$0.65

Apparatus was set up to measure the dielectric constant ϵ' and the loss ϵ'' in liquid, solid, and gas phases. A coaxial dielectric cell and a 3-terminal liquid cell were constructed. The real and imaginary parts of the dielectric constants of some alkyl amines were measured in the solid phase. The dielectric constant and loss factor of the binary mixtures of benzonitrile and propionitrile were measured and the data analyzed in terms of two partly superimposed Debye regions. The dielectric constant and loss factor of mixtures of benzonitrile with acetonitrile were measured. A systematic study of the loss factor versus frequency of pure chloroform was undertaken. At 30°C, the dielectric constant and loss of aniline, O-chloroaniline, and anisole were measured. The dispersion and absorption of microwave radiation by $CClF_3$, CHF_3, $CHClF_2$, COS, CF_4, and C_2ClF_5 were measured to calculate effective collision diameters. NSA

N68-22787# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ON A POSSIBILITY OF PARAFIELDS REPRESENTATION OF THE INNER DEGREE OF FREEDOM OF THE ISOSPIN AND STRANGENESS TYPE [O VOZMOZHNOSTI PARAPOLEVOGO PREDSTAVLENIYA VNUTRENNIKH STEPENEI SVOBODY TIPA IZOSPINA I STRANNOSTI]

A. B. Govorkov 1967 21 p refs In RUSSIAN
(JINR-P4-3602)

A possibility is shown of introducing the inner degrees of freedom of the isospin and strangeness type on the basis of the paracommutation Green–Volkov relations. For this purpose it is suggested that all the irreducible (separable) representations of parafermion relations of the second and the third order be considered, and then different inner states of paraparticles be interpreted as the states belonging either to different irreducible representations or to those which differ by the symmetry of the vector state indices. In the case of the second order an explicit matrix transformation from the parafield to the system of two usual fields (obeying the "isotopic" symmetry) is given. Within the framework of the parafield theory an electromagnetic interaction, violating the symmetry, is introduced. In the case of the third order the mentioned classification of the particle states coincides with that according to "strangeness" and "isomultiplets." Author (NSA)

N68-22788# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

PHOTOPRODUCTION OF ρ^0 MESONS ON HYDROGEN, CARBON, AND ALUMINUM WITH PHOTONS OF KNOWN ENERGY

H. Blechschmidt, J. P. Dowd, B. Elsner, K. Heinloth, K. H. Hoehne et al Oct. 1967 13 p refs
(DESY-67/30)

Photoproduction of pion pairs on hydrogen, carbon, and aluminum at photon energies between 3.2 and 4.9 GeV was investigated in a spark chamber experiment in order to study the production of ρ^0 mesons. Values were obtained for ρ^0 masses from a Breit–Wigner fit, which are in good agreement with other experiments. Total and differential cross sections for the process $\gamma + A \rightarrow \rho^0 + A$ were also obtained. The energy dependence of the forward cross section was found to exhibit a behavior in accord with diffraction production. NSA

N68-22789# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

SEARCH FOR EXCITED BARYONS IN PERIPHERAL NUCLEUS–NUCLEUS INTERACTIONS IN NUCLEAR EMULSION

A. Jurak 1967 14 p refs
(INR-P-816/6/PH)

From a sample of peripheral nucleus–nucleus collisions a group of events was selected which can be regarded with a high degree of probability as a sub-sample of interactions of a pair of quasi-free nucleus, constituents of the colliding nuclei. An analysis of angular distributions of these has shown a significant difference between the interactions with small number of charged particles produced $/1 \leq n_m \leq 3/$ and these with a higher one $/4 \leq n_m \leq 12/$. The angular distributions of the former are not inconsistent with the assumption that meson production in these events occurs through intermediate isobar states with mass of about 2.5 GeV/c^n. Author (NSA)

N68-22791# United Kingdom Atomic Energy Authority, Harwell (England).

ROLE OF FOCUSING COLLISIONS IN THE PROCESS OF RADIATION ANNEALING OF POINT DEFECTS IN DIAMOND

I. V. Al'tovskii, V. I. Karpukhin, V. A. Nikolayenko, and P. A. Platonov May 1967 14 p refs Transl. into ENGLISH from Russian Rept. IAE-1091
(NP-tr-1612; IAE-1091) CFSTI: HC$3.00/MF$0.65

A theoretical investigation was made on the basis of a proposed model of radiation annealing using the concept of dynamic crowdions. An expression was obtained for the dependence of the volumetric expansion of the lattice parameter of diamond on the total dose of neutrons. The length of both the dynamic crowdions and the cross-section for annihilation of a vacancy and crowdion for diamond were also obtained. Author (NSA)

N68-22793# Akademiya Nauk URSR, Kiev. Institut Theoreticheskoi Fiziki.

FORMULATION OF THE ADIABATIC HYPOTHESIS IN AXIOMATIC FIELD THEORY [O FORMULIROVKE ADIABATICHESKOI GIPOTEZY V AKSIOMATICHESKOI TEORII POLYA]

B. V. Medvedev and M. K. Polivanov 1967 12 p refs In RUSSIAN Presented at the Axiomatic Quantum Field Theory and Elementary Particles, Kiev
(ITF-67-24; CONF-670544-5)

Certain prescriptions which are equivalent to the adiabatic hypothesis are formulated in the framework of axiomatic approach. The eventual occurrence of the δ-function derivatives in coefficient functions in renormalized theories makes them necessary. Author (NSA)

N68-22794# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ELECTROMAGNETIC TRANSITIONS IN ^{15}N AND ^{15}O NUCLEI [ELEKTROMAGNITNYE PEREKHODY V YADRAKH ^{15}N I ^{15}O]

M. A. Zhusupov and R. A. Eramzhyan 1968 8 p refs In RUSSIAN
(JINR-P4-3684)

The probabilities of electromagnetic transitions in ^{15}N and ^{15}O nuclei are calculated within the shell model with intermediate coupling. Author (NSA)

N68-22797# Akademiya Nauk URSR, Kiev. Institut Theoreticheskoi Fiziki.

INTERACTION WITH DERIVATIVES MODEL THE UITARITY PROBLEM AND NORMAL FORM OF SOLUTION [MODEL VZAIMODEISTVIYA S PROIZVODNYMI. PROBLEMA UNITARNOSTI I NORMAL'NAYA FORMA RESHENIYA]

B. V. Medvedev, M. K. Polivanov, and A. D. Sukhanov 1967 29 p In RUSSIAN Presented at the Axiomatic Quantum Field Theory and Elementary Particles Conf., Kiev
(ITF-67-26; CONF-670544-6)

An interaction-with-derivatives model, leading to the renormalization of field operators is considered. The Lagrangian T_w-exponent is shown to be nonunitary in this model but this nonunitarity is of C-number type. Nevertheless the Heisenberg operators obtained earlier turn out to be hermitean. A current given, the unitary S-matrix is constructed, the latter being represented as normal exponent with nonhermitean index. The formulation of the unitarity condition for S-matrix of like form leads to a similarity with the optical theorem. Author (NSA)

N68-22798# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.

AXIAL CONSTANT RENORMALIZATION BY MEANS OF RELATIVISTICALLY-INVARIANT QUARK MODEL [NAKOZHDENIE RENORMALIZATSIONNOI AKSIAL'NOI KONSTANTY S POMOSHCH'YU RELYATIVISTSKI-INVARIANTNOGO URAVNENIYA DLYA SOSTAVNYKH CHASTITS]

V. P. Shelest 1967 11 p refs In RUSSIAN
(ITF-67-18)

An equation of the Bethe–Salpeter type was used for baryons as compound particles. A solution was obtained on the basis of the quasi-independent quarks. A formula for the renormalization of the axial constants, obtained by P. N. Bogolyubov, was derived.
Author (NSA)

N68-22799# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

MANY PARTICLE TRANSFER REACTIONS

O. Dumitresku (Bucharest Univ.) 1967 22 p refs
(JINR-E4-3624)

An explicit expression for the matrix element for the (^{6}Li,p) stripping reaction with finite-range interaction for both spherical and deformed nuclei is given.
Author (NSA)

N68-22800# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

RECURSION RELATION FOR THE 3-J SYMBOLS

M. Miku 1967 9 p refs
(JINR-E2-3625)

The realization of the SU(2) group by boson operators gives a simple definition for the 3-j symbols as a scalar product for states with three different bosons. Manipulation of the boson operators from one part of the scalar product to another gives recursion relations for the 3-j symbols. By taking into account the symmetries of the 3-j symbols there are six independent recursion relations but this number is reduced to two by the new symmetries discovered by Regge.
Author (NSA)

N68-22826# Iowa State Univ. of Science and Technology, Ames.

MEASUREMENTS OF SOME GAMMA-RAY RELATIVE INTENSITIES AND INTERNAL CONVERSION COEFFICIENTS USING A BENT-CRYSTAL MONOCHROMATOR

Gerald C. Nelson and E. N. Hatch Nov. 1967 149 p refs
(Contract W-7405-ENG-82)
(IS-1730) CFSTI: HC$3.00/MF$0.65

The X-ray and gamma-ray relative intensities were measured from the decay of ^{170}Tm, ^{166}Ho, ^{180m}Hf, ^{155}Eu, and ^{155}Sm with a bent-crystal monochromator and a linear least-squares computer program. The K-shell internal conversion coefficients were determined for the E2 transitions in ^{170}Yb and ^{166}Er. The results for these $2^+ \rightarrow 0^+$ transitions are five percent higher than the theoretical values for these transitions. From the relative intensities of the transitions in ^{180}Hf, it was possible to deduce a value for the total internal conversion coefficient for the 93.3-keV transition of $\alpha_T^{93} = 4.91 \pm 0.23$. Using the previous measurements of conversion electron intensities of Edwards and Boehm and the present measured gamma-ray relative intensities, internal conversion coefficients for all the other transitions were obtained. From the X-ray and gamma-ray relative intensities of the transitions in ^{155}Gd and the previous measurement of the ratio of K conversion electrons for the 86- and 105-keV transitions of Subba Rao, it was possible to determine the K conversion coefficients for the 86- and 105-keV transitions of $\alpha_K = 0.43 \pm 0.06$ and $\alpha_K = 0.23 \pm 0.03$. The relative intensities of the 246-, 142-, and 104-keV gamma rays following the decay of 22-min ^{155}Sm were determined with improved precision in order that they might be used to determine accurately the conversion coefficients for these transitions.
Author (NSA)

N68-22835# Gulf General Atomic, San Diego, Calif.

GAMBLE-5: A PROGRAM FOR THE SOLUTION OF THE MULTIGROUP NEUTRON-DIFFUSION EQUATIONS IN TWO DIMENSIONS, WITH ARBITRARY GROUP SCATTERING, FOR THE UNIVAC-1108 COMPUTER

J. P. Dorsey and R. Froehlich 4 Dec. 1967 78 p refs
(Contract AT(04-3)-167)
(GA-8188) CFSTI: HC$3.00/MF$0.65

The computer program GAMBLE-5 finds, over a nonuniform rectangular mesh imposed upon a rectangular area of either the x–y or the v–z plane, a discrete numerical solution to the multi-group, time-independent neutron diffusion equations for a heterogeneous reactor. The program can handle an arbitrary group scattering matrix and fission transfer from each group into any other group. The numerical methods used in the FORTRAN IV code are described, together with input preparations, edits, and operating instructions.
NSA

N68-22837# Lyon Univ. (France). Institut de Physique Nucleaire.

REACTIONS OF (α,t) AND (α,He-3) ON C-12

R. Bouche, L. Feuvrais, M. Gaillard, P. Gaillard, M. Gouanere et al Jun. 1967 11 p refs Presented at Brela Symp., Yugoslavia, Jun. 1967
(LYCEN-6747; CONF-670629-6)

The energy spectra of alpha particles, tritons, and ^{3}He from the bombardment of a polystyrene foil with 56-MeV alpha particles were measured together with angular distributions for the reactions $^{12}C(\alpha,{}^3He)^{13}C$ and $^{12}C(\alpha,t)^{13}N$ to the ground states of ^{13}C and ^{13}N and to an excited level at about 3.7 MeV. The angular distribution for elastic scattering of 56-MeV alpha particles from ^{12}C was also obtained. The angular distributions for the reactions to the ground states were analyzed using entrance channel parameters that were obtained by an optical-model fit to the elastic scattering data. The (α,^{3}He) and (α,t) reactions were also studied on ^{10}B, ^{40}Ca, ^{14}N, and ^{32}S, with emphasis on the ratios of the cross sections. It was observed that the (α,^{3}He) cross section was always larger than the (α,t) cross section; but it was not possible to attribute this effect uniquely to a Coulomb barrier, different binding energies, or different overlap integrals.
NSA

N68-22838# Lyon Univ. (France). Institut de Physique Nucleaire.

GRAPHICAL TREATMENT OF INELASTIC NUCLEAR SCATTERING THEORY

E. El-Baz and B. Castel 12 Jun. 1967 15 p refs
(LYCEN-6743)

The theory presented deals with the angular momentum aspects of nuclear inelastic scattering. In a preceding article, a graphical approach analogous to the one used here described a reaction characterized by a well-defined intermediate state. Here, no such state is considered, and it is shown that the graphical description permits a clear view of angular, tensorial, and radial dependences of the interaction matrix and the determination of the probability of observation when polarization is included.
Author (NSA)

N68-22862# Princeton Univ., N. J. Palmer Physical Lab.

WHY WE NEED BETTER HIGH ENERGY TOTAL CROSS SECTION MEASUREMENTS

Harry J. Lipkin Nov. 1967 9 p refs Presented at the Conf. on High-Energy Collisions of Hadrons, Geneva
(Contract AT(30-1)-937)
(PUB-937-284; CONF-680103) CFSTI: HC$3.00/MF$0.65

The particular importance for a better understanding of hadron dynamics of total cross section measurements at higher energies and of more precise measurements in the energy of 6 to 20 GeV is pointed out. Total cross sections, regularities in experimental data, symmetry and universality, and possible experimental approaches are considered.
NSA

N68-22863# Oak Ridge National Lab., Tenn.

CRITICAL EXPERIMENTS WITH ENRICHED URANIUM METAL–POLYETHYLENE, PLEXIGLAS, AND TEFLON MIXTURES

D. W. Magnuson Feb. 1968 38 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2082) CFSTI: HC$3.00/MF$0.65

Reflected and unreflected critical experiments were performed at $H:{}^{235}U$ atomic ratios from 0 to 5 in rectangular geometry with layers of enriched uranium and polyethylene. Base dimensions of the assemblies were 5×10 and 10×10 in. In some unreflected experiments, the metal was interleaved with Plexiglas and with Teflon at only the latter base dimensions. Heterogeneity effects were found to be small from experiments assembled from the same or approximately the same materials but with different layer thicknesses. Values of k_{eff}, calculated with the KENO Monte Carlo code, are in excellent agreement with the experimental values. By equating geometrical bucklings for rectangular and spherical geometry, these data were converted to critical masses for spheres. Comparisons of the experimental values were made to the critical masses calculated by the ANISN transport code for homogeneous spheres. Author (NSA)

N68-22864# Oak Ridge National Lab., Tenn.

SELECTED ABSTRACTS OF NON-U.S. LITERATURE ON PRODUCTION AND INDUSTRIAL USES OF RADIOISOTOPES

Martha Gerrard and P. S. Baker Feb. 1968 59 p
(Contract W-7405-ENG-26)
(ORNL-TM-1940, Pt. 2) CFSTI: HC$3.00/MF$0.65

More than 575 abstracts of non-U.S. publications on production and use of radioisotopes and radiation, selected from the July–December issues of Nuclear Science Abstracts (1967) are presented. Author (NSA)

N68-22865# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.

A COMMENT ON THE IDENTIFICATION OF H.I.,XN REACTION PRODUCTS FROM EXCITATION FUNCTIONS [NEKOTORYE ZAMECHANIYA OB IDENTIFIKATSII PRODUKTOV REAKTSII (H.I.,XN) PO KRIVYM VOZBUZHDENIYA]

V. Noibert and K. Aleksander 1968 13 p In RUSSIAN
(JINR-P7-3657)

Various possibilities for determining the mass number of (H.I.,xn) reaction products from excitation functions are investigated. On the basis of 56 well-established excitation functions, the applicability of Alexander and Simonoff's empirical relation is checked. Using a simple statistical model of neutron evaporation including the effect of nuclear rotation, the average kinetic energy and number of evaporated neutrons are calculated. In most cases a fair agreement between experimental and calculated values is obtained. Author (NSA)

N68-22866# Oak Ridge National Lab., Tenn.

PROMPT NEUTRON DECAY AND REACTIVITY MEASUREMENTS IN SUBCRITICAL URANIUM METAL CYLINDERS

J. T. Mihalczo Feb. 1968 35 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1736) CFSTI: HC$3.00/MF$0.65

Prompt neutron decay constants have been determined for unreflected and unmoderated subcritical cylinders of enriched uranium (93.15% ^{235}U) by the Rossi-α technique. The cylinder diameters were 17.77, 27.94, and 38.09 cm and the heights, at these diameters, varied from 10.184 to 2.548, 8.431 to 5.399, and 7.502 to 4.780 cm, respectively. The decay constants agreed to within 4% with those measured by the pulsed neutron method; the comparison with the results of S_n transport theory calculations showed disagreements as large as 20%. Reactivities as much as 33 dollars subcritical were determined from the prompt neutron decay constant at delayed criticality and changes in the prompt neutron lifetime with cylinder height calculated by S_n transport theory. These reactivities agreed favorably with values determined by an analog computer whose input was the response of an ionization chamber to power changes when an assembly was disassembled from delayed criticality to a given reactivity. Author (NSA)

N68-22867# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.

PERSPECTIVE VIEWS ON THE SYNTHESIS OF NEW ISOTOPES AND ELEMENTS [PERSPEKTIVY SINTEZA NOVYKH IZOTOPOV I ELEMENTOV]

G. N. Flerov 1967 18 p refs In RUSSIAN
(JINR-D7-3623)

The synthesis of new isotopes and elements is discussed. Methods of producing new isotopes, including neutron reactions, heavy-ion reactions, and heavy ion-induced fission are considered. NSA

N68-22868# Clermont-Ferrand Univ. (France).

THEORETICAL AND EXPERIMENTAL STUDY OF BEAM OF PHOTONS OF HARD BREMSSTRAHLUNG RADIATION [ETUDE THEORIQUE ET EXPERIMENTALE D'UN FAISCEAU DE PHOTONS DE RAYONNEMENT DE FREINAGE DURCI EN ENERGIE]

Pierre-Yves Bertin (Ph.D. Thesis) [1966] 109 p refs In FRENCH
(NP-17237)

High-energy photon beams are studied. A method of γ spectrometry is defined for which the application permits verification of various hypotheses used in studying the beam. From this an experiment on the photoproduction of π^+ and π^0 mesons in hydrogen around threshold is considered. Electron bremmsstrahlung phenomena, photon production from electron–positron pairs, and problems of multiple coulomb scattering are considered. Various solutions are studied for a photon beam. Monoenergetic electron bremsstrahlung was selected for the experimental studies. The beam construction and the experimental techniques used are described. The processing applied to the raw data to eliminate multiple Coulomb scattering and bremsstrahlung effects is described. Calculations for the coherence of photon beam decay in the lithium hydride column is verified by comparison of the experimental spectrum with the result of photon spectra convolution and the differential cross section for the opening angle in photon production. Author (NSA)

N68-22869# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

RELATIONS BETWEEN THE CROSS SECTIONS OF INELASTIC SCATTERING PROCESSES AT HIGH ENERGIES [SOOTNOSHENIYA MEZHDU SECHENIYAMI NEUPRUGIKH PROTSESSOV RASSEYANIYA PRI BOL'SHIKH ENERGIYAKH]

L. Enkovski 1967 5 p refs In RUSSIAN
(JINR-P2-3649)

Relations connecting cross sections of the meson–baryon scattering at high energies of the type $0^- + 1/2^+ \to 0^- + 3/2^+$ are derived. Author (NSA)

N68-22870# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ON THE MECHANISM OF $\pi^\pm$ ABSORPTION BY LIGHT NUCLEI [O MEKHANIZME POGLOSHCHENIYA $\pi^\pm$ LEGKIMI YADRAMI]

T. I. Kopaleishvili and F. G. Tkebuchava 1968 13 p refs In RUSSIAN
(JINR-P4-3666)

The reaction (π^-n) with stopped π^+ mesons and the reaction (π^+p) with moving π^+ mesons on ^{12}C and ^{16}O nuclei are investigated within the one-particle absorption mechanism. It is shown that the probability (cross section) of these reactions is by two (one) orders smaller than the probability (cross section) of the corresponding two-nucleon reactions (π^-NN) and (π^+NN). Author (NSA)

N68-22871# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

INVESTIGATION OF THE POTENTIAL DISTRIBUTION IN THE TWO-DIMENSIONAL MODEL OF A SYNCHROCYCLOTRON ACCELERATING GAP IN THE PRESENCE OF THE SPATIAL CHARGE [ISSLEDOVANIE RASPREDELENIYA POTENTSIALA V DVUMERNOI MODELI USKORYAYUSHCHEGO PROMEZHUTKA SINKHROTSIKLOTRONA PRI NALICHII PROSTRANSTVENNOGO ZARYADA]

A. N. Safonov and L. A. Shekhtmai 1967 27 p refs In RUSSIAN
(JINR-P9-3639)

An electrical field of the two-dimensional model of a synchrocyclotron accelerating gap in the presence of the cylindrical and semicylindrical spatial charge is investigated. The measurements were taken by the induced current method by using the probe with the linear charge distribution. The value of the space charge densities is found out at which a complete ion source shielding from the dee accelerating field takes place. The obtained results can be applied for the estimation of the critical densities of the space charge in real configurations of an accelerating gap. Author (NSA)

N68-22880# Institutt for Atomenergi, Kjeller (Norway).

NEUTRON SCATTERING FROM MAGNETITE BELOW 119°K

E. J. Samuelsen, E. J. Bleeker, L. Dobrazynski, and T. Riste Oct. 1967 24 p refs
(KR-122)

A neutron scattering experiment to look for spin-wave excitation energy changes of magnetite at the transition point 119°K showed no such change. During this work it was discovered, however, that the low-temperature structure gives rise to weak extra neutron diffraction lines that can be indexed as (h,k,l + 1/2) in cubic indices. From the observed neutron polarization sensitivity of the intensities and the increasing structure factors with increasing sin θ/λ, it is concluded that the extra reflections are not directly due to magnetic ordering (ferrimagnetic spirals or Fe^{2+}–Fe^{3+} ordering on the octahedral sites). Rather they are caused by a lowering of the crystal symmetry. Author (NSA)

N68-22896# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

ABSORPTION EFFECTS FOR HIGH ENERGY PHOTONS

G. Kramer, K. Schilling, and L. Stodolsky Nov. 1967 13 p refs
DESY-67/37)

The contribution of the intermediate vector meson state in photoproduction is equal in strength to the direct Born terms and when combined with the Born term, can give an effect simulating strong absorption for the photon. Author (NSA)

N68-22899# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

ON A POSSIBILITY OF TESTING CPT-INVARIANCE [OB ODNOI VOZMOZHNOSTI PROVERKI CPT-INVARIANTNOSTI]

L. I. Lapidus 1967 10 p refs In RUSSIAN; ENGLISH summary Submitted for publication
(JINR-P2-3622)

The possibility and the sensitivity of the verification of CPT-invariance in the $K^0 \longrightarrow 2\pi$ decay are considered. NSA

N68-22900# Joint Inst. for Nuclear Research, Dubna (USSR). High Energy Lab.

INVESTIGATION OF THE PROPERTIES OF SLOW π^+ PRODUCED IN π^-Xe INTERACTIONS AT 9 GEV/C [ISSLEDOVANIE SVOISTV MEDLENNYKH π^+ OBRAZOVANNYKH VO VZAIMODEISTVIYAKH π^-Xe PRI GEV/C]

V. Gadomskii, B. Slovinskii, and Z. S. Strugalskii 1967 10 p refs In RUSSIAN
(JINR-P1-3640)

An investigation is made of multiplicity, angular distributions, and momentum characteristics of π^+-mesons with the momentum 50 MeV/c $\leq P_{\pi^+} \leq$ 150 MeV/c produced in 9 GeV/c π^--Xe interactions. Author (NSA)

N68-22901# Saskatchewan Univ., Saskatoon. Accelerator Lab.

THE INTERACTION OF HIGH ENERGY ELECTRONS WITH ^{6}Li AND ^{7}Li

Ronald M. Hutcheon (Ph.D. Thesis) Nov. 1967 162 p refs
(SAL-8)

The 140-MeV electron linear accelerator was used to measure the electron scattering and electrodistintegration cross sections of ^{6}Li and ^{7}Li. The inelastic electron scattering form factors were measured for the low-lying excited states of both isotopes, and in some cases there are large discrepancies between the present and previous results. Most of these were traced to the presence of a very large quasi-continuous cross section underlying the narrow levels of both ^{6}Li and ^{7}Li. Because of the improved resolution, in the present experiment the narrow peaks were resolved from the continuous background whereas, in previous cases, a large portion of the continuous cross section had been included in the area of the peaks. The present results have greatly simplified the interpretation of the low-excitation energy levels in both nuclei. The theoretical fits to the ^{6}Li elastic and inelastic form factors indicate that the data can not be fitted using a simple harmonic oscillator model with the same oscillator parameter for the s- and p-shells. However consistent results are obtained using an s-shell parameter of approximately 1.63 fm and a p-shell parameter of approximately 2.0 fm. In ^{6}Li the broad quasicontinuous cross section is peaked at approximately 4 MeV and has a width of about 2.5 MeV, while in ^{7}Li the peak in the cross section is at approximately 5 MeV and the width is much larger. An attempt was made to determine some of the properties of these broad levels which seem to be associated with the α-d and α-t decay of ^{6}Li and ^{7}Li, respectively. In ^{7}Li the reduced E2 transition probabilities of the 4.63- and 6.6-MeV states were measured; they tend to verify a rotational model for the first four states of ^{7}Li. The giant resonance regions of the lithium isotopes were studied at both low and high momentum transfers by inelastic electron scattering and by electrodisintegration. The data from the latter experiments is very difficult to interpret, but, although they yielded no new nuclear information an approximate test of the virtual photon formalism was provided. The present low momentum transfer inelastic electron scattering spectra taken in the giant resonance region are quite different from previous results and indicate a great deal of structure. The high momentum transfer data taken in the same region of excitation energy suggest that an α-d model may be applicable to ^{6}Li when the interaction wavelength is short enough. Author (NSA)

N68-22903# Commissariat a l'Energie Atomique, Saclay (France).

ACTIVATION ANALYSIS USING γ PHOTONS [ANALYSE PAR ACTIVATION AUX PHOTONS γ]

Charles Engelmann Dec. 1967 62 p refs In FRENCH
(CEA-R-3307) CFSTI: HC $3.00/MF $0.65

This report summarizes data required for using photonuclear reactions in the field of analysis. After a review of the elementary properties of nuclear reactions induced by photon irradiation, the main characteristics are given of high energy ($E > 20$ MeV) bremsstrahlung sources. The principles of activation analysis based on the use of photons are given. Analytic possibilities are described in detail, in particular for the determination of very small quantities ($< 10^{-6}$) of C, N, O, and F. Nuclear reaction interferences are discussed. Author

N68-22907# Grenoble Univ. (France).

BETA AND INTERNAL CONVERSION ELECTRON SPECTRA OF THE 25.6 KEV TRANSITION IN THE DECAY $^{231}Th \rightarrow {}^{231}U$. [SPECTRE BETA ET ELECTRONS DE CONVERSION INTERNE DE LA TRANSITION DE 25.6 KEV DE LA DESINTEGRATION $^{231}Th \rightarrow {}^{231}U$

Jean Bernard Cardona 30 Sep. 1966 25 p refs In FRENCH
(NP-17208)

The beta and internal conversion electron spectra of the 25.6-keV transition was measured using a 21-cm double-focusing magnetic beta spectrometer. The ^{231}Th was separated from the parent isotope ^{235}U by ion exchange, and thin sources were prepared. The spectra obtained are given and are in agreement with those of previous studies. The analysis of the internal conversion electron spectrum confirms the E1 nature of the 25.6-keV transition. Author (NSA)

N68-22910# South Carolina Univ., Columbia. Dept. of Physics and Astronomy.

ANTINEUTRINO SPECTRUM FROM URANIUM-235 FISSION PRODUCTS

F. T. Avignone, III and C. W. Darden, III Dec. 1967 45 p refs
(Contract AT(38-1)-474)
(SRO-141) CFSTI: HC$3.00/MF$0.65

The energy spectrum of antineutrinos emitted by binary fission fragments of ^{235}U in secular equilibrium was calculated. The primary fission yields, used in this calculation, were calculated using the primary fission product charge distributions of A.C. Wahl. The yields are tabulated for 405 primary theoretically predicted fission products. The antineutrino spectrum derived was used to calculate the average cross section per antineutrino for the reactions $\nu\,(p,n)e^{+}$ and $\nu\,(^{3}He,^{3}H)e^{+}$. The cross sections are 1.09×10^{-43} cm^{2}/neutrino and 2.46×10^{-43} cm^{2}/neutrino respectively. The total number of antineutrinos per fission predicted with the calculated spectrum is 6.06. Author (NSA)

N68-22912# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

SOME CONSEQUENCES OF ANALYTICITY AND UNITARITY

A. A. Logunov and Nguyen Van Hieu 1967 17 p refs Transl. into ENGLISH from Russian
(JINR-E2-3655)

Results concerning the asymptotic behavior of the cross sections of elastic and inelastic processes are presented. They were reported previously. For the sake of simplicity all particles are assumed to be spinless. Author (NSA)

N68-22918# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

DEVELOPMENT OF STATISTICAL INTERPRETATION OF QUANTUM MECHANICS BY MEANS OF THE JOINT COORDINATE-MOMENTUM REPRESENTATION

A. A. Tyapkin 1968 37 p refs Transl. into ENGLISH from Russian
(JINR-E4-3687)

The problem of the determination of a trajectory or probability density in phase space according to the known statistical distributions for momenta and coordinates is considered. For the first time for a typical quantum case of harmonic oscillator motion in the zero state the positive probability has been obtained everywhere in the joint coordinate–momentum representation. The conclusion is drawn that the main peculiarities of microparticle motion (zero energy, uncertainty relation, the tunnel effect and the principally unremovable statistical character of description) are due to the virtual process of interaction with zero oscillations of physical vacuum. Author (NSA)

N68-22921# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

ANALYSIS OF THE PERIPHERAL MODEL FOR THE PROCESS $p+p \rightarrow p+n+\pi^{+}$ AT 0.5 TO 0.7 GEV

V. K. Suslenko and V. J. Kochkin 1967 25 p refs Transl. into ENGLISH from Russian
(JINR-E2-3638)

The comparison of theoretical calculations performed on the basis of peripheral model taking into account the energy and momentum conservation laws by using the convenient reference system (L_{π}-system) was made with π^{+}-meson experimental data for the process $p+p \rightarrow p+n+\pi^{+}$ at incident energies $T = 556$ and 660 MeV and different lab angles. As a consequence of good qualitative agreement the applicability of the peripheral model concepts in the given energy region was shown to be possible. Author (NSA)

N68-22927# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

INVESTIGATION OF POSITIVE PION MESON CAPTURE BY HYDROGEN IN HYDROGENOUS SUBSTANCES [ISSLEDOVANIE ZAKHVATA POSITIVE PION MEZONOV VODORODOM V VODORODOSODERZHASHCHIKH VESHCHESTVAKH]

Z. V. Krumshtein, V. I. Petrukhin, L. I. Ponomarev, and Yu D. Prokoshkin 1967 15 p refs In RUSSIAN
(JINR-P13-3653)

A probability of π^{-}-meson capture by hydrogen in the $Z_m H_n$ hydrides and compounds of $Z_k Z_l H_n$ type is investigated. The measurements were carried out by comparing of π^{0}-meson yields from the targets investigated and from the LiH target. It is shown that the model of "large mesic molecules" describes well the obtained results. Meanwhile the initial capture obeys the "Z-law": a probability of π^{-} meson capture in $Z_m H_n$ hydrides changes strongly from period (which determines Z atom) to period of the periodic table and depends also upon the type of chemical bond. Author (NSA)

N68-22928# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

FORWARD PEAK IN POSITIVE PION PHOTOPRODUCTION

G. Buschhorn, P. Heide, U. Koetz, R. A. Lewis, P. Schmueser et al Nov. 1967 6 p refs Prepared jointly with Hamburg Univ.
(DESY-67/35)

Previous measurements of single π^{+} photoproduction on protons at 2.6 and 5 GeV were extended to small t-values, i.e., $(t) = 0.002$, 0.0004, and 0.0001 (GeV/c)^{2}. The results demonstrate the absence of a forward dip and therefore disagree with simple Regge pole models. NSA

N68-22939# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.

RENORMALIZATION OF THE AXIAL VECTOR CURRENT

Varukhan Zavonovich Baluni, Laslo Laslovich Enkovski, and Valerii Vasil'evich Kukhtin 1967 8 p refs
(ITF-67-19)

It is shown that the Adler–Weisberger relation can be obtained in any theory exhibiting a symmetry between the axial and axial-vector currents in the sense that corresponding bare constants are equal. NSA

N68-22940# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.

ON DECOMPOSITION OF IRREDUCIBLE REPRESENTATIONS OF SEMISIMPLE LIE GROUP INTO REPRESENTATIONS OF ITS SEMISIMPLE SUBGROUP

A. U. Klymyk 1967 32 p refs
(ITF-67-17)

The problem of the decomposition of irreducible (finite-dimensional and some infinite-dimensional unitary) representations of a semisimple Lie algebra into representations of its semisimple subgroup is considered. The decomposition of unitary representations of the maximal-degenerate series for the complex unimodular group A_1 and the complex symplectic group C_1 into the representations of the like subgroup is given. NSA

N68-22942# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.

APPLICATION OF PERTURBATION THEORY TO INVERSE POWERS OF THE INTERACTION PARAMETERS FOR A SYSTEM OF THREE NUCLEONS [PRIMENENIE TEORII VOZMUSHCHENII PO OBRATNYM STEPENYAM PARAMETRA VZAIMODEISTVIYA K SISTEME TREKH NUKLONOV]

G. F. Filippov and V. I. Ovcharenko 1967 15 p refs In RUSSIAN
(ITF-67-12)

An approximate method of solving the problem of bound states of a system of N particles is developed in which the expansions in inverse powers of the interaction parameter are used. The wave functions of the two-body oscillator potential system are chosen as zero-order approximations. To show the effectiveness of the method, the binding energy of a three-particle system is calculated. Author (NSA)

N68-22944# European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau.

RELATIVISTIC CALCULATIONS OF KINEMATIC PARAMETERS FOR NUCLEAR REACTIONS

H. Horstmann and H. Liskien 6 Oct. 1967 32 p refs
(EUR-3668)

A FORTRAN program for relativistic calculations of general kinematic parameters for nuclear reactions is described. The usefulness of the program is demonstrated by means of calculations for neutron-producing reactions. Author (NSA)

N68-22945# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

INTRANUCLEAR CASCADE WITH MANY-PARTICLE INTERACTIONS [VNUTRIYADERNYE KASKADY S MNOGOCHASTICHNYMI VZAIMODEISTVIYAMI]

I. Z. Artykov, V. S. Barashenkov, and S. M. Eliseev 1967 35 p refs In RUSSIAN
(JINR-P2-3604)

The cascades, initiated in various nuclei by mesons and nucleons of any energy from several GeV to about 10^3 GeV, are considered using the Monte Carlo method. It was taken into account that several particles, produced in foregoing acts of interaction, can interact simultaneously with an intranuclear nucleon. The account of such many-particle interactions is quite necessary to explain the experiments in the energy range $T \gtrsim 100$ GeV, where these interactions are several dozens of percent. For $T \lesssim 10$ GeV the fraction of many-particle interactions is also rather essential (in photo-emulsion ≈20%). However, the average characteristics of pion–nucleus and nucleon–nucleus interactions are weakly affected. Information on the angular and energy distributions of particles, produced in many-particle interactions, is obtained. These distributions are qualitatively very similar to the corresponding distributions from inelastic pion–nucleon interactions. Author (NSA)

N68-22961# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

ELECTROPRODUCTION OF ρ^0 MESONS

H. Blechschmidt, J. P. Down, B. Elsner, K. Heinloth, P. Karow et al Dec. 1967 10 p refs
(DESY-67/41)

A large contribution of multiple meson (π) production was found in a spark chamber experiment. The process $e+p \rightarrow e'^{0}+p'+\pi^{+}+\pi^{-}$ at 4.9 GeV was studied. The invariant mass spectrum of the two-meson (π) for the electroproduced events shows a clear peak around the mass of the meson (ρ^0). The differential cross section for the electroproduction of mesons (ρ^0) is shown as a function of the momentum transfer to the nucleon. From the experimental results this differential cross section is predicted to be (120 ± 34) $(e^{(10\pm5k)})$ μ b/GeV^2. The agreement with experimental results indicates that within the experimental accuracy the contribution of the small longitudinal field component of the virtual photon to the cross section does not cause a significant shift of the cross section behavior in the case of ρ^0 electroproduction. NSA

N68-22962# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ANALYTIC CONTINUATION IN THE COUPLING CONSTANT IN THE NONRENORMALIZABLE FIELD THEORY MODEL

B. A. Arbuzov, N. M. Atakishiev, and A. T. Filippov 1967 15 p refs Submitted for publication
(JINR-E2-3610)

A method is developed for constructing the exact solution of the Dyson equation in the nonrenormalizable field theory with the interaction Lagrangian $L_{int} = g\bar{\Psi}\gamma_n\Psi\alpha^n\phi$, ψ and ϕ being spinor and scalar fields respectively. The method is based on the analytic continuation in the coupling constant g, the necessity for which being tightly connected with an exponential singularity of the spinor Green function in the complex momentum plant at infinity. This singularity does not violate the conditions of the localizability of the theory. The method is applicable to more realistic field theories. Author (NSA)

N68-22964# Commissariat a l'Energie Atomique, Saclay (France).

MEASUREMENT AND ANALYSIS OF HIGH ENERGY RADIATION THROUGH ACTIVATION DETECTORS. APPLICATION IN DOSIMETRY [SUR LA MESURE ET L'ANALYSE DES RAYONNEMENTS DE HAUTE ENERGIE PAR DETECTEURS A ACTIVATION. APPLICATION A LA DOSIMETRIE]

Laodamas Sklavenitis (Ph.D. Thesis—Toulouse Univ.) 1967 41 p refs In FRENCH; ENGLISH summary
(CEA-R-3376) CFSTI: HC$3.00/MF$0.65

Possibility of measurement and analysis of radiation fluences within objects of small volume submitted to a high energy proton beam is described. A detailed study of the radiation nature and energy spectra as well as of the various dosimetry methods is presented. In order to select a group of detectors, high energy nuclear reactions were systematically studied and for some of them cross sections were measured or calculated. Application of the forementioned analysis to radiation within a tissue equivalent phatom irradiated by 3GeV protons is presented. This analysis is sufficiently detailed to allow the reconstitution of the absorbed doses, the dose equivalent and, contingent on a better knowledge of the dose due to heavy particles, the quality factors of the measured doses and the corresponding detector activities revealed the possibility that some detectors could give directly the absorbed dose, or even the dose equivalent, by a simple activity measurement. Author

N68-22967# Hamburg Univ. (West Germany).

NEUTRON FORM FACTORS FROM ANALYSIS OF DEUTERON ELECTRODISINTEGRATION EXPERIMENTS

D. Hasselmann and G. Kramer Sep. 1967 19 p refs
(DESY-67/21)

Electromagnetic form factors of the neutron are calculated from recent quasielastic electron–deuteron scattering experiments. The theory used in the analysis includes a realistic description of the deuteron and rescattering corrections. Author (NSA)

N68-22968# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.

PDQ-40: AN IBM 7040-44 PROGRAM FOR THE SOLUTION OF THE STEADY STATE NEUTRON DIFFUSION EQUATIONS IN TWO DIMENSIONS

R. J. Wagner and George R. Poetschat (Idaho Nucl. Corp.) Nov. 1967 48 p refs
(Contract AT(10-1)-205)
(IDO-17257) CFSTI: HC$3.00/MF$0.65

The program PDW-40, an IBM 7040-44 computer program which obtains a numerical solution to the few group, time-independent, two-dimensional neutron diffusion equations, is described. The solution is obtained either over a rectangular surface in x-y coordinates or over a right cylinder in r-z coordinates. The number of lethargy groups is limited to four, and the total number of points of solution is limited to 20,000. Either a zero flux or zero derivative (mirror symmetry) condition can be applied along each exterior boundary of the problem. In addition, a 180° rotational symmetry condition can be applied along the top boundary or a 90° rotational symmetry condition can be applied along the top and left side of a problem. Up to 255 materials with differing nuclear properties can be placed in a problem. The conditions of continuity of flux and current are used at diffusion region interfaces, and logarithmic derivative conditions can be applied at internal boundaries for control rod descriptions. Either a normal or an adjoint calculation can be performed. The output of the code consists of the eigenvalue, group flux edits, source edit, power edit, and various integrated quantities. Author (NSA)

N68-22979# General Dynamics Corp., San Diego, Calif. General Atomic Div.

GANDY: A COMPUTER PROGRAM FOR THE EVALUATION OF EFFECTIVE CROSS SECTIONS IN THE UNRESOLVED RESONANCE REGION

S. C. Cohen and P. K. Koch 22 May 1967 59 p refs
(Contract AT(04-3)-167)
(GA-8003) CFSTI: HC$3.00/MF$0.65

A computer program, GANDY, was written to evaluate temperature-dependent effective neutron capture, fission, and scattering cross sections in the unresolved resonance region. Utilizing the isolated resonance approximation, the code considers s-, p-, and d-wave neutron orbital angular momenta and includes the effect of interference scattering. Fissile cross sections are computed for chi-squared fission width statistical distributions with one, two, three, or four degrees of freedom. The program was written in the FORTRAN-4 language and was run on a Univac-1108 computer. Author (NSA)

N68-22985# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.

THE NEUTRON INELASTIC CROSS SECTION FOR THE PRODUCTION OF ^{103m}Rh

J. P. Butler and D. C. Santry Mar. 1968 10 p refs Presented at 2nd Conf. on Neutron Cross Sect. and Technol., Washington, D. C., 4–7 Mar. 1968
(AECL-3043) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

The cross section for the threshold reaction ^{103}Rh(n,n')^{103m}Rh has been measured by the activation method from 0.18 to 14.8 MeV. Neutrons with an energy spread varying from ±30 to ±80 keV were obtained from the T(p,n)^{3}He, D(d,n)^{3}He and T(d,n)^{4}He reactions using an EN tandem Van de Graaff accelerator and a 2 MeV accelerator. For energies below 5.5 MeV the neutron flux was determined with a calibrated neutron long counter while at higher energies the measurements were made relative to the known cross section for ^{32}S(n,p)^{32}P reaction. The cross section for ^{103}Rh(n,n')^{103m}Rh increases rapidly with energy from a value of 25±3 mb at 0.18 MeV to a maximum of 1385±55 mb near 6 MeV. The decrease in slope at 300 and 800 keV is attributed to the appearance of levels of negative parity which prefer to decay to the ground state, while the increase at 550 keV is caused by levels which decay to the isomeric state. From the excitation curve an effective cross section of 716±40 mb was calculated for a fission–neutron spectrum. Author

N68-22987 European Organization for Nuclear Research, Geneva (Switzerland).

ANGULAR ACCEPTANCE OF QUADRUPLE TURNING [ACCEPTANCE ANGULAIRE DU QUADRUPLET DE RETOURNEMENT]

E. Regenstreif 27 Feb. 1968 102 p refs In FRENCH
(CERN-68-6)

The general theory of angular acceptance of a multiplet quadripole is formulated, and the angular acceptance of a reversing quadruplet is studied as a function of such physical parameters as the magnetic gradient of the lens, the length of the magnetic elements, and the length of the slip interval. Consideration is also given to the problem of transmitting the beams between the source and the image. It is shown that the reversing apparatus finds its principal applications in the high frequency separations of high energy, and that the acceptance of such a device rapidly decreases the energy function. An attempt is made to calculate that effect and to determine the conditions leading to a maximal acceptance and consequently an optimal transmission of the beams. Transl. by M.G.J.

N68-22995# Commissariat a l'Energie Atomique, Saclay (France).

DETERMINATION OF A 14 MEV NEUTRON FLUX BY COPPER ACTIVATION [DETERMINATION D'UN FLUX DE NEUTRONS DE 14 MEV PAR ACTIVATION DU CUIVRE]

Daniel Ameline and Andre Bertin Nov. 1967 26 p refs In FRENCH; ENGLISH summary
(CEA-R-3295) CFSTI: HC$3.00/MF$0.65

Copper becomes radioactive after irradiation by 14 MeV neutrons produced by the reaction T(d,n)He^4. By measuring this radioactivity an evaluation of the neutron flux may be obtained. Results are presented obtained with a special $4\pi\beta$ detector which we have developed, as well as those obtained using conventional equipment. We have tried to measure with the maximum accuracy the number of neutrons emitted by continuous or pulsed generators: the greatest error is due to the uncertainty in the cross-section value which may attain 7 per cent. Our results are in good agreement with those obtained: on the one hand by counting the α particles associated with a solid detector, and, on the other hand by counting with a bismuth activation detector for which this study has been undertaken. Author

N68-23001# Commissariat a l'Energie Atomique, Saclay (France).

CONTRIBUTION TO THE EXPERIMENTAL STUDY OF THE CRITICAL SCATTERING OF COLD NEUTRONS IN IRON

[CONTRIBUTION A L'ETUDE EXPERIMENTALE DE LA DIFFUSION CRITIQUE DES NEUTRONS FROIDS PAR LE FER]

Konstantinovic Jovan (Ph.D. Thesis—Paris Univ.) Jan. 1968 72 p refs In FRENCH
(CEA-R-3317) CFSTI: HC$3.00/MF$0.65

Studied were magnetic fluctuations produced by neutron scattering in iron in the neighborhood of the Curie temperature. The theory of neutron scattering by magnetic substances and Landau's theory of second order phase transitions are used to derive the magnetic cross section. The experimental apparatus is described and the results of the experiments are presented. The results confirm the four-third law obeyed by the magnetic susceptibility near the Curie point as predicted by recent theories based on the Heisenberg model; however, a non-zero relaxation time is apparent for the magnetic fluctuations at the Curie point, which is in disagreement with theoretical conclusions. K.W.

N68-23013# California Univ., Berkeley. Lawrence Radiation Lab.
ENERGY LEVEL CALCULATIONS FOR SINGLY IONIZED HAFNIUM
Rolf Mehlhorn (Ph.D. Thesis)
(Contract W-7405-ENG-48)
(UCRL-18040) CFSTI: HC$3.00/MF$0.65

The parametric theory of atomic structure was used to derive formulas for matrix elements, including those of configuration interaction not hitherto available in the literature. These formulas were incorporated into a series of computer codes for calculating matrix elements, energy levels, g values, and intensities. The programs were designed to deal with the commonly occurring configurations 1^n, $1^{n-1}1'$, and $1^{n-2}1'1''$. With the aid of these programs an analysis of Hf II was conducted. The odd parity levels could be described with a mean error of 143 cm^{-1} for 56 energies, corresponding to about 0.5% of the configuration width. However, many calculated g-values did not agree with the observations. Therefore a new least squares fit, utilizing both the g-values and energy levels was developed. With this fit the mean error for the g-values was reduced from .100 to .023, but the error in energies rose to 453 cm^{-1} for 62 energies. To investigate the eigenvector errors, intensities were calculated. An admixture of excited configurations into the known eigenvectors, depending linearly on the energy of the known level, was postulated. In the final result the mean error for 300 observed transitions was about 50%, due to large experimental errors. Author (NSA)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N68-21865 Stanford Univ., Calif.
TEMPERATURE MEASUREMENT AND INTERNAL FLOW HEAT TRANSFER ANALYSIS FOR PARTIALLY IONIZED ARGON
Frank Paul Incropera (Ph.D. Thesis) 1966 180 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-4374

From a review of the arc jet literature, three techniques are found to be best suited to the task of plasma jet temperature measurement. Two of these techniques are spectroscopic and are referred to as the Larenz and two-line methods, and the third is calorimetric and operates by insertion of a probe in the plasma stream. An uncertainty analysis performed on each of the selected methods indicates that the most suitable spectroscopic technique is one which combines the ion-neutral, two-line method with the Larenz method. Spectroscopic and calorimetric probe measurements of temperature profiles in the same argon plasma source agree to within 4 per cent, which is also the expected uncertainty predicted from the analysis. Dissert. Abstr.

N68-21922 California Univ., Los Angeles.
SOLID STATE PLASMA WAVEGUIDES: MICROWAVE PROPAGATION AND FARADAY EFFECT
Hiromu John Kuno (Ph.D. Thesis) 1966 206 p
Available from Univ. Microfilms: HC $9.45/MF $3.00 Order No. 67-4742

The theoretical and experimental investigations of microwave propagation and the Faraday effect in a circular solid state plasma waveguide under a longitudinal magnetic field are presented. Possible microwave device applications of the Faraday effect in a solid state plasma are also considered and experimentally demonstrated. Dissert. Abstr.

N68-21923* Techtran Corp., Glen Burnie, Md.
CONFINEMENT OF A PLASMA BY A ROTATING FIELD. THE STABILITY OF THE PLASMA-GENERATOR SYSTEM [CONFINEMENT D'UN PLASMA PAR CHAMP TOURNANT LA STABILITE DU SYSTEME GENERATEUR-PLASMA]
Erich S. Weibel Washington NASA Apr. 1968 11 p refs Transl. into ENGLISH from Lab. de Rech. sur la Phys. des Plasmas, Rept. LRP-27-66
(Contract NASw-1695)
(NASA-TT-F-11622; LRP-27/66) CSCL 20I

The radio frequency generators supplying the power to build up the confining fields and to heat the plasma are coupled to the latter optimally. The low frequency stability of this system is analyzed, taking into account the increase in time of the plasma temperature and of the field amplitude. The system is shown to be stable. Author

N68-21962 Maryland Univ., College Park.
SCATTERING OF TEST-PARTICLES BY WAVES IN PLASMAS CONTAINING SUPRATHERMAL PARTICLE POPULATIONS
Aharon Eviatar (Ph.D. Thesis) 1966 108 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-6274

A Fokker-Planck equation including wave-particle interactions is used to describe the evolution of a distribution of test-particles in a magnetic field-free spatially homogeneous plasma. This equation is used to calculate the scattering of a test particle by enhanced electric field fluctuations in plasma containing both suprathermal and thermal electrons. The theory is extended to include the case of ion waves propagating in a current-bearing plasma. Characteristic times for wave-particle scattering in such plasmas are evaluated in terms of the coefficients of the equation and calculated explicitly for some particular distributions. It is found that interaction with electron plasma oscillations is competitive with whistlers in the scattering of suprathermal electrons and that ion waves are the dominant mechanism for the diffusion of subthermal and thermal electrons across the magnetopause and the earth's bow shock wave. Dissert. Abstr.

N68-21970 Texas Univ., Austin.
STUDIES OF THE LOWER HYBRID RESONANCE IN A FINITE LENGTH PLASMA
George Scott Mills (Ph.D. Thesis) 1966 69 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-3331

A theoretical treatment of the propagation of the extraordinary wave across the static magnetic field in a dense plasma has been extended to the case of a plasma which is finite in the direction of the magnetic field. This model indicates that propagation at less than 90° to the magnetic field, required in order to match the boundary condition at the ends, results in values of ω_o/ω which are less than 1. $\omega_o=(\omega_{ci}\omega_{ce})^{1/2}$ is the lower electron-ion hybrid frequency. The decrease in ω_o/ω is increased by further reduction in plasma length as well as by increase of the ion mass. The good agreement between these experiments, in which significant deviations of ω_o/ω from 1 were encountered, and the theory used to obtain the calculated values confirms the validity of such a simple model. This experimental confirmation of the theory opens the way for its application to further studies of the lower hybrid resonance, particularly in the area of non-collisional heating effects.

Dissert. Abstr.

N68-21971 Florida Univ., Gainesville.

INVESTIGATION OF THE SCATTERING OF LASER LIGHT BY A PLASMA

William Henry Mc Mahan (Ph.D. Thesis) 1966 93 p

Available from Univ. Microfilms: HC $4.80/MF $3.00 Order No. 67-3489

In experimental studies, light from a continuous-wave Argon ion laser was scattered by an Argon plasma generated by a theta pinch. Resonance scattering was observed both by angular scattering techniques and by interferometry. The scattering data were correlated with properties of the plasma by measuring the time-resolved spectra of the plasma. The time-resolved density of excited states of Argon II was measured and the relationship of these density data to local thermal equilibrium in the plasma is discussed.

Dissert. Abstr.

N68-22027 Pennsylvania Univ., Philadelphia.

TEMPERATURE MEASUREMENT OF AN ALKALI METAL SEEDED PLASMA IN AN ELECTRIC FIELD

Tsu-Kai Chu (Ph.D. Thesis) 1966 124 p

Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-3058

The gas temperature and the electron temperature of a potassium-and-sodium (Na-K alloy, 9 to 1 by weight) seeded plasma are measured. The carrier gas is argon at atmospheric pressure and is confined in a circular-cylinder geometry. Four seeding concentrations are reported here, with Na-K-to-argon ratio (by weight) α at 0.132%, 0.198%, 0.396% and 0.93%. Results of gas temperature measurements show that the gas temperature increases in the presence of an applied electric field. The radial distribution of gas temperature is nearly uniform, with deviation from uniformity beginning at about $r/r_o=0.8$. The radial distribution of electron temperature is also found nearly uniform. For the two cases of low-seeding concentration, the measured electron temperature agrees with that calculated from an energy-balance equation when radiation loss is included in the calculation. For the two higher-concentration cases, the measured electron temperature is lower than the calculated value.

Dissert. Abstr.

N68-22028 Texas A&M Univ., College Station.

PLASMA ELECTRON THERMALIZATION MEASUREMENTS UTILIZING THE SPECTRAL DISTRIBUTION OF LASER LIGHT SCATTERED BY PLASMA ELECTRONS

Paul Jean Bottoms (Ph.D. Thesis) 1966 72 p

Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-4697

The Thompson-scattering method has been used to investigate the thermalization of plasma electrons in hydrogen, helium and argon plasmas. The thermalization measurements were made after the injection of the plasma into a semi-cusp magnetic field. The magnetic field was found to be effective in isolating the plasma while the thermalization measurements were made. The measurement of the temporal development of the plasma electron temperature yielded experimental results that were found to be in good agreement with the thermalization theory of Spitzer and Sivukhim. The results did, however, indicate a slower electron heating rate than is predicted by the theory. This effect is believed to have been caused by the loss of high energy electrons during the thermalization process.

Dissert. Abstr.

N68-22073# Aktiebolaget Atomenergi, Stockholm (Sweden).

SPECTROSCOPIC STUDY OF RECOMBINATION IN THE EARLY AFTERGLOW OF A HELIUM PLASMA

J. Stevefelt Feb. 1968 49 p refs

(AE-311) CFSTI: HC$3.00/MF$0.65

Some properties of a decaying helium plasma have been studied using time resolved spectroscopy and probe diagnostics. The plasma was produced in a pulsed, repetitive, hot cathode discharge in helium at a pressure 11 torr, and the light emitted in the afterglow of the discharge was measured by means of a spectrometer–photomultiplier combination. Single photoelectrons were counted on a scaler during a preset gate time of each discharge cycle, and after a preset number of cycles recorded on punched tape. The spectrometer was calibrated for absolute intensity measurements of the spectral lines of atomic helium. The overall conductance of the positive column was determined by measuring the voltage difference between two probes inserted into the plasma, passing a very small current pulse between the anode and cathode in the afterglow. Heavier current pulses were used to heat the free electrons selectively, thus providing so-called "afterglow quenching".

Author

N68-22075 California Univ., Berkeley.

A SHOCK TUBE STUDY OF THE KINETICS OF THERMAL IONIZATION

Herbert Ross Hawkins (Ph.D. Thesis) 1966 175 p

Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-5074

Measurements have been made of the rate of thermal ionization of xenon and xenon–neon mixtures. A pressure-driven shock tube fitted with an improved longitudinal microwave probe was used to monitor the time-varying electron concentration. One set of experiments at 6500°K and 3×10^{18} atoms/cm^3 was used to compare the relative efficiencies of xenon atoms. An impurity level of 0.4×10^{-6} in xenon of some easily ionized but unknown substance contributed heavily to ionization at early times. In a second set of experiments at 8500°K, the transition from atom–atom to electron–atom ionizing processes was observed at electron concentrations roughly near those predicted.

Dissert. Abstr.

N68-22077 Stanford Univ., Calif.

UHF-PLASMA INTERACTION: THE TWO-STREAM INSTABILITY OF A CURRENT-CARRYING PLASMA

Joel Carlton Hosea (Ph.D. Thesis) 1966 152 p

Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-4367

The collective space charge interaction between the electron and ion streams of a current-carrying plasma results in the enhancement of electrostatic oscillations carried by the two streams. When the relative drift velocity between the electrons and ions exceeds a critical value of the order of the electron thermal velocity, some oscillations begin to grow exponentially in amplitude and the two-stream instability of a current-carrying plasma ensues. This study comprises a thorough experimental investigation of the onset properties of this instability and an examination of its nonlinear properties.

Dissert. Abstr.

N68-22104 Stanford Univ., Calif.

A UNIFIED TREATMENT OF THE RELAXATION PHENOMENON IN RADIATING ARGON PLASMA FLOWS BEHIND INCIDENT AND BOW SHOCK WAVES

Peter Ernest Oettinger 1966 115 p
Available from Univ. Microfilms: HC $5.60/MF $3.00 Order No. 67-4415

The electronic relaxation of a shock heated, nonequilibrium argon plasma flow is treated. A physical model of the flow is postulated which includes the microscopic collisional and radiative processes. When coupled with the macroscopic conservation laws, this leads to a rigorous formulation of the equations governing the relaxing flow. A resultant numerical solution for the flow behind a strong incident shock front propagating into argon gas is compared to time-resolved interferograms. Good agreement is obtained between theory and experiment for incident shock Mach numbers of 11 to 18 propagating into argon at pressures of 3 to 5 mm Hg. The experimental investigation is extended into the argon shock layer preceding a cylinder-plate. An attempt is made to use the formulated equations to predict conditions along the stagnation streamline, when the flow can either be considered one-dimensional or at constant density across most of the shock layer. Comparison of experimental and theoretical results show that neither one of these postulated flows actually exists. Dissert. Abstr.

N68-22157# Royal Inst. of Tech., Stockholm (Sweden). Plasma Physics Div.

PENNING DISCHARGE IN A STRONGLY INHOMOGENEOUS MAGNETIC MIRROR FIELD

N. Hopfgarten, R. B. Johansson, B. Nilsson, and H. Persson Mar. 1968 22 p refs Submitted for publication
(Rept.-68-05) CFSTI: HC $3.00/MF $0.65

In a Penning discharge in a magnetic mirror field with an axial mirror ratio $B_{max}/B_{min} = 40$, a burning voltage as high as 20 kV with a current of a few amps is observed. Normally the gas is hydrogen in the pressure range 10^{-4}–10^{-3} torr. The classical mean free path is longer than or comparable with the dimensions of the device. From calorimetric measurements on the cathodes, the plasma density and ion energy in the cathode regions are estimated to a few times 10^{10} cm^{-3} and a few keV, respectively. Magnetic loop measurements in the anode region indicate a plasma energy density in that region of 10^{12}–10^{13} eV/cm^3. Neutral particles, emitted perpendicular to the magnetic field, with energies exceeding 4 keV, are observed with a scintillator. Measurements on a split anode show oscillations in the frequency range 3–20 kHz. The aim of the experiment is to investigate the potential distribution in this type of low-density plasma, in particular the electric field component parallel to the magnetic field, and to determine the energies of the plasma particles. Author (ESRO)

N68-22159 New York Univ., N. Y.

EXPANSION OF CYLINDRICAL PISTON INTO A CONDUCTING FLUID

Martin Avery Snyder (Ph.D. Thesis) 1966 136 p
Available from Univ. Microfilms: HC $6.60/MF $3.00 Order No. 67-6053

The linearized expansion of an infinitely long cylindrical piston into a conducting fluid is considered. The surface of the piston is assumed to be a perfect conductor. The fluid is assumed to be a perfect compressible fluid (free from viscosity and heat conduction) and a perfect electrical conductor, permeated by a uniform magnetic field. Conical solutions of the linearized Lundquist equations are obtained by an extension of the conical plane wave method. In general, the solution involves both real and complex characteristics. Slow expansions of pistons with roughly circular cross-section and finite-speed expansions of thin pistons are considered. The linearized problem appears to be a faithful model of the nonlinear problem only for pistons whose cross-section is nearly parallel to the undisturbed magnetic field. In other cases, the presence of a magnetic boundary layer is suggested. The linearized solution for a thin piston with finite expansion speed is obtained, and appears to be physically relevant. Dissert. Abstr.

N68-22164# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

MEASUREMENT OF THE CONDUCTIVITY AND OF THE VELOCITY OF A DENSE PLASMA ACCELERATED BY AN MF ELECTROMAGNETIC FIELD [MESURE DE LA CONDUCTIVITE ET DE LA VITESSE D'UN PLASMA DENSE ACCELERE PAR UN CHAMP ELECTROMAGNETIQUE MOYENNE FREQUENCE]

Gerard Fournier, Jean-Pierre Rager, and Bernard Sitt 1968 15 p refs In FRENCH Presented at the Colloq. on Interaction of High Freq. Fields with a Plasma Saclay, France, 15–18 Jan. 1968 Submitted for publication
(ONERA-TP-543) CFSTI: HC $3.00/MF $0.65

A simple formula that accounts for local conductivity is given for flow in an annular inductive machine where the current density is expressed in terms of the electric and magnetic fields and the flow velocity. Macroscopic characteristics of the temperature and speed of the plasma formed can be evaluated by this formula which is considered applicable to all inductive systems for which the current density and the relative electric fields follow this relationship. Transl. by M.W.R.

N68-22173 Stanford Univ., Calif.

BOUNDARY LAYER STRUCTURE IN A SHOCK-GENERATED PLASMA FLOW

Per Stellan Knoeoes (Ph.D. Thesis) 1966 213 p
Available from Univ. Microfilms: HC $9.70/MF $3.00 Order No. 67-4384

The structure of some laminar boundary layers in high density, shock-heated, 1 eV argon plasma flows is investigated theoretically and experimentally. The theoretical analysis is based upon a three-fluid continuum formulation. The boundary layer equations are solved numerically on a digital computer by a finite difference technique for the case of thermochemical equilibrium and no applied electromagnetic fields, neglecting radiation. The shock tube side-wall boundary layer is studied experimentally with a new simple quantitative schlieren technique. The refraction of light passing through 1 mm thick boundary layers is measured for two separated wavelengths from displacements of two shadows formed by inclined thin wires in point source light, which is reflected in an "off-axis" (large spherical abberation) concave spherical mirror. The experiments, which are of exploratory nature only, clearly demonstrate the feasibility of the technique in analyzing plasma boundary layer flows. Dissert. Abstr.

N68-22182 Princeton Univ., N. J.

WEAK TURBULENCE IN A HOMOGENEOUS PLASMA

Ronald William Crosby Davidson (Ph.D. Thesis) 1966 143 p
Available from Univ. Microfilms: HC $6.80/MF $3.00 Order No. 67-5713

The problem of weak plasma turbulence is considered within the framework of the B-B-G-K-Y hierarachy of equations for a fully ionized, magnetic field-free, spatially homogeneous, ensemble of slightly unstable (in velocity space), multispecies, plasmas. The final equations advanced in time, the one-particle distribution function f(1), and the wave energy density ψ_k. Included are the nonlinear effects of wave–wave interactions as well as the linear and nonlinear effects of wave-particle scattering. Various properties of the final kinetic equations for f(1) and ψ_k are considered. In a separate example a simple model equation exhibiting solely wave–wave interactions, is considered. The principle of ensemble averaging at an early stage is considered in reference to the Vlasov–Poisson

equations in the problem of weak turbulence in a plasma. It is shown that this approach leads to equations for correlations, identical to the B-B-G-K-Y hierarchy if the particle-particle terms associated with the discreteness of matter are omitted from the latter formalism.
Dissert. Abstr.

N68-22183 Connecticut Univ., Storrs.

A COINCIDENCE STUDY OF ARGON ION-ATOM COLLISIONS AT KILOVOLT ENERGIES

Quentin Cattell Kessel (Ph.D. Thesis) 1966 99 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-3890

Single collisions of Ar^+ on Ar, at 25 to 400 keV for scattering angles from 8 to 40 degrees, have been studied using a coincidence scattering apparatus. For the reaction $Ar^+ + Ar \rightarrow Ar^{+n} + Ar^{+m} + (n+m-1)e$ the charge states n and m $(0 \leq n$ or $m \leq 8)$ of both particles from the same collision were determined. The experiment found the probabilities of seeing n and m in coincidence and investigated the possibility of a correlation between n and m. In addition, simultaneous measurements of the scattered and recoil angles after collision determined the inelastic energy loss for the above reaction with n and m specified. The data show that in general, there is little or no correlation between n and m. Where correlation is found (for distances of closest approach of about 0.24A° and 0.09A°), the data suggest that it may be attributed to levels of excitation existing in argon atoms.
Dissert. Abstr.

N68-22185 Oregon State Univ., Corvallis.

THE PRESSURE EFFECT AND TIME RESOLUTION OF HELIUM MOLECULAR BANDS IN A PULSED MICROWAVE PLASMA

Merlin Frank Anderson (Ph.D. Thesis) 1967 169 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-5396

The behavior of all of the observed molecular band emission as well as the prominent atomic line emission from a pulsed microwave helium plasma is given. The plasma is produced in a cylindrical pyrex tube contained in a square wave-guide section using pulsed x-band radiation from a 725A magnetron. From the variations of the light intensity as a function of time, together with the pressure and power effects it is concluded that the molecular radiation follows from the same process both during and after the microwave excitation pulse. Because of the extensive pressure variation, significant changes in the temporal light intensity of the atomic emission are also observed. These observations show that the excitation pulse period emission and the afterglow emission are significantly different. The dominant process during the excitation pulse is undoubtedly inelastic electron excitation of the helium atom.
Dissert. Abstr.

N68-22186 New York Univ., N. Y.

TOTAL THERMAL ENERGY CROSS SECTION MEASUREMENTS FOR THE SCATTERING OF ALKALI ATOMIC BEAMS BY ALKALI GASES AND PLASMAS IN THERMODYNAMIC EQUILIBRIUM

Edward Gray (Ph.D. Thesis) 1966 253 p
Available from Univ. Microfilms: HC $11.50/MF $3.30 Order No. 67-6022

Attenuation measurements were made for the scattering of velocity-selected thermal energy lithium and potassium beams by cesium gas, cesium and potassium crossed-beams, and by a highly ionized cesium plasma. The mean power dependence of the potassium-cesium total cross section (nineteen runs), evaluated by a least squares analysis, is 0.413±.043 over the mean relative speed $(\bar{v}_r)$ range 550–1290 meters/sec. This result is in close agreement (3%) with the theoretically predicted $\bar{v}_r^{-2/5}$ dependence for a r^{-6} interaction potential. Two potassium–potassium crossed-beam runs have a mean power dependence 0.381±.004 over the relative speed range 661–1331 meters/sec. The lithium–cesium total cross section was found to be approximately velocity-independent over the relative speed range 1031–2824 meters/sec. Measured potassium–cesium absolute total cross sections agree, to within an order of magnitude, with previous experimental results and theoretical estimates.
Dissert. Abstr.

N68-22189# Royal Inst. of Tech., Stockholm (Sweden). Plasma Physics Div.

SCREENING OF A HIGH-DENSITY PLASMA FROM NEUTRAL GAS PENETRATION

B. Lehnert 18 Mar. 1968 29 p refs
(Rept.-68-06) CFSTI: HC$3.00/MF$0.65

In certain fusion reactors in stationary operation, neutral gas surrounds a magnetically confined plasma. The inflow of neutrals and the outflow of plasma by diffusion or free streaming in closed and open-ended systems is studied in this paper. In a closed bottle, neutral gas fails to penetrate through the cool boundary layers into the hot core of a high-density plasma. At densities below 10^{19} m^{-3}, the penetration depth of the neutrals depends on the ionization rate and becomes about 10^{-3} and 0.1 m at the densities 10^{21} and 10^{19} m^{-3}. Neutral gas inflow is delayed by diffusion through a cool boundary region of sufficiently high density. In stationary operation the magnetic field strength and the surrounding neutral gas density determine the plasma density. A condition for stable heat balance in a boundary region of finite thickness is deduced in this paper. It is possible to surround a high-density plasma by a neutral gas blanket dense enough for released wall impurities to diffuse only slowly toward the plasma boundary. With neutral gas superimposed along the plasma boundary, the impurities can be removed before reaching the plasma. In open-ended systems, plasma particles escaping along the magnetic field and recombining at the end walls form thin layers of neutral gas. The theory agrees with measurements of the density of a fully ionized plasma as a function of the applied magnetic field and the density of the surrounding neutral gas.
Author (ESRO)

N68-22245 Maryland Univ., College Park.

WAVES IN A PLASMA IN A MAGNETIC FIELD

Howard Martin Stainer (Ph.D. Thesis) 1966 87 p
Available from Univ. Microfilms: HC $4.60/MF $3.00 Order No. 67-6149

Two examples of slightly nonlinear wave propagation in a collisionless plasma permeated by a uniform background magnetic field B_0 are discussed. The first calculation considers externally generated electromagnetic waves propagating along B_0 in a plasma described by the first three moment equations obtained from the Vlasov Equation. The second calculation is motivated by the investigation of the line splitting observed in plasma radiation (Type II radio bursts) from the Sun. Here internally excited longitudinal electrostatic oscillations propagating at arbitrary angles with respect to B_0 are considered. Collisions between these electrostatic plasma waves generate electromagnetic radiation at approximately the plasma frequency for electron-ion plasma wave collisions, and radiation at approximately twice the plasma frequency for electron–electron interactions.
Dissert. Abstr.

N68-22254 Purdue Univ., Lafayette, Ind.

A THEORETICAL INVESTIGATION OF MAGNETOHYDRODYNAMIC TURBULENCE

John Howard Thomas (Ph.D. Thesis) 1966 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-5503

The theory of turbulence in an incompressible, viscous, electrically-conducting fluid is formulated probabilistically through the use of the joint characteristic functional and the functional calculus. Dynamical equations and conditions for the joint characteristic functional are derived from the equations of magnetohydrodynamics. Dynamical equations for various order space-time correlations between velocity and magnetic field components are derived by expanding the joint characteristic functional in a functional Taylor series. Closure methods for this system of equations are discussed. The entire formulation is transformed to wave-number space and new equations governing the joint characteristic functional are derived. Solutions for the joint characteristic functional are obtained for the special cases of stationary turbulence in an inviscid fluid with infinite electrical conductivity and turbulence in the final stages of decay. Dissert. Abstr.

N68-22292 Lehigh Univ., Bethlehem, Pa.
ELECTROSTATIC EFFECTS IN THE SHOCK TUBE
Fred Arthur Grosse (Ph.D. Thesis) 1966 130 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-4863

Electrostatic signals are observed when a weak shock wave, which produces no ionization in the body of the gas, initiates flow of a gas in a shock tube having glass or Lucite walls. A transient voltage is induced in a ring of metal foil on the outside of a 1-1/2" glass or Lucite shock tube. These voltages were recorded by a single sweep oscilloscope with the foil connected directly to the input or through an electrometer having an adequate long-time response as well as a rapid rise time. The oscilloscope single sweep was triggered by an upstream shock detector. With the foil connected directly to the oscilloscope an initial voltage pulse of minus 10 volts accompanied the arrival of an $M_s = 6$ shock in dry nitrogen gas, and a minus 50 millivolt signal accompanied the arrival of an $M_s = 1.2$ shock in nitrogen or in air. Other parts of the signals were associated with flow features such as transition of the boundary layer from laminar to turbulent and the arrival of the cold front. Dissert. Abstr.

N68-22294 Yale Univ., New Haven, Conn.
INTERACTION OF PLASMAS AND RADIATION. (PARTS 1-3)
Brian Logan Murphy (Ph.D. Thesis) 1966 98 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-3451

Three aspects of a system composed of electrons, atoms (or ions), and electromagnetic radiation are studied. The central issue treated is that of the coupling between the charged particles of the plasma and the radiation field. The harmonic fields generated when the frequency of electron collisions with neutral atoms is modulated by a microwave field are determined. The starting point of the calculation is the Boltzmann equation. The classical circulation of energy between an electron and the radiation field is investigated in the second part using the methods of Prigogine and his collaborators. This phenomenon is found to be similar to the virtual processes of quantum electrodynamics in that the electron's properties are altered. The final part is concerned with the possibility that radiation of optical frequencies may act in a manner analogous to the pumping field of a conventional atomic maser and thereby produce continuous amplification of microwave radiation. Dissert. Abstr.

N68-22314*# Westinghouse Electric Corp., Baltimore, Md. Surface Div.
THE PLASMA DISPLAY—A DIGITALLY CONTROLLABLE, HIGH BRIGHTNESS DISPLAY WITH AN INHERENT MEMORY
R. H. Willson *In* NASA. Washington Recent Advan. in Display Media 1968 p 113-121 refs (See N68-22302 12-09)

This paper discusses in detail the characteristics of the plasma display. Also covered are the history of the development, cell construction, and the experimental setup used to measure the cell characteristics, a few of the experimental results which shed light on the mechanisms responsible for the cell's behavior, an explanation of the bistable characteristic, techniques for writing and erasing, the current status of the display, and, finally, problem areas and possible solutions. Author

N68-22330*# Scripta Technica, Inc., Washington, D. C.
INJECTION OF A PLASMA INTO A CLOSED MAGNETIC TRAP WITH A DOUBLE-HELIX FIELD [INZHEKTSIYA V ZAMKNUTUYU MAGNITNUYU LOVUSHKU S DVUKHODNYM VINTOVYM POLEM]
G. M. Batanov, S. Ye. Grebenshchikov, M. A. Ivanovskiy, I. S. Sbitnikova, G. I. Fedyanin et al Washington NASA Apr. 1968 19 p refs Transl. into ENGLISH from the publ. "Fizika Plazmy" Moscow, Nauka Press, 1966 p 7-19
(Contract NASw-1694)
(NASA-TT-F-11631) CFSTI: HC $3.00/MF $0.65 CSCL 20I

In the experimental study of various plasma-injection approaches, the methods discussed include (1) injection into a programmed magnetic field, (2) injection along a cluster of magnetic-field lines of force expanded outside the magnetic-field perimeter, and (3) injection by colliding plasma fluxes in the transverse magnetic field of a toroidal trap. Strong effects of a helical external magnetic field on the plasma containment time, density, and distribution over the trap cross section are established. It is believed that effective plasma injection into closed magnetic systems can be achieved when these methods are developed further. Author

N68-22366*# Volt Technical Corp., Washington, D. C.
ON SOME QUESTION OF ELECTROMAGNETIC WAVES' DIFFRACTION ON PLASMA FORMATIONS
V. B. Gil'denburg, Yu. M. Zhidko, I. G. Kondrat'yev, and M. A. Miller 30 Apr. 1968 21 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz. (USSR), v. 10, no. 9-10, p 1358-1375
(Contract NAS5-12487)
(NASA-CR-94361; ST-PP-EMWD-AI-10707) CFSTI: HC $3.00/MF $0.65 CSCL 20I

This review paper is the consequence of plasma introduction as a medium with specific electromagnetic properties in the problems of diffraction. The diversified requirements for practical applications, for radiocommunication in the presence of ionization irregularities, and with regard to the ionosphere are contained in four major sections: (1) Limiting cases of low and high plasma density—born approximation, and dense plasma with sharp or weakly-blurred boundaries; (2) numerical computations and shortwave approximation for a plasma of any density—reflection from a uniform nonabsorbing sphere, weak plasma boundary washing, and plasma with strongly washed boundary; (3) resonance scattering on small plasma objects—dipole resonance in cold plasma; and (4) diffraction on bodies placed in a nonuniform plasma. Author

N68-22389*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A RESUME OF RESEARCH ON COAXIAL PLASMA GUNS PERFORMED AT LEWIS RESEARCH CENTER
Charles J. Michels Washington 1968 18 p refs Presented at the Seminar on Coaxial Plasma Guns, Catholic Univ. of America, Wash., D. C., 10 May 1968
(NASA-TM-X-52431) CFSTI: HC $3.00/MF $0.65 CSCL 20I

An effort to determine the potential of the gun for space propulsion applications is described. The experimental parametric examination of various gun geometries, the theoretical analysis of capacitor bank-variable mass distribution gun systems, and the plasma diagnostics of various geometries is summarized. The results indicated that the efficiency (≈40 percent) was too low to be competitive with alternative systems. Propellant, switching, and heat-rejection systems proved to be complicated. Author

N68-22414# California Univ., Berkeley. Lawrence Radiation Lab.
PLASMA CONTAINMENT IN THE 2X EXPERIMENT
F. H. Coensgen, W. F. Cummins, R. E. Ellis, F. R. Kovar, and W. E. Nexsen, Jr. 1 Nov. 1967 17 p refs Presented at Intern. Conf. on Plasma Confined in Open-Ended Geometry, Gatlinburg, Tenn., 1–3 Nov. 1967
(Contract W-7405-ENG-48)
(UCRL-70656; CONF-671127-1) CFSTI: HC $3.00/MF $0.65

In the 2X experiment, plasma containment in open-ended systems is studied by rapidly creating a plasma then making time dependent measurements of density, ion energy, electron temperature, end losses, cross field transport, radiation, etc. Although low order interchange instabilities were suppressed in simple mirror systems by line-tying, higher order modes persisted so that it was impossible to evaluate the contribution of high frequency fluctuations to the observed anomalously rapid plasma loss. With conventional vacuum conditions (base pressure $\approx 5 \times 10^{-7}$ torr) attempts to suppress the low frequency instabilities by transforming to a minimum-B containment field after the plasma was trapped encountered a very rapid plasma loss which was found to be associated with an influx of neutral gas. By reducing the base pressure to the 10^{-9} torr range and evaporating titanium throughout the entire chamber the neutral influx was reduced and at least one instability suppressed. Thus plasma with density up to 5×10^{13} cm^{-3} was injected under conditions where lifetime in a quasi-stationary minimum-B field was not limited by ion–ion scattering, electron cooling, charge exchange or interchange instabilities. Author (NSA)

N68-22545# Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki.
APPLICABILITY OF RANDOM PHASE APPROXIMATION FOR NONLINEAR WAVE INTERACTIONS IN PLASMA [OB USLOVIYAKH PRIMENIMOSTI PRIBLIZHENIYA KHAOTICHESKIKH FAZ DLYA NELINEINOGO VZAIMODEISKIKH FAZ DLYA NELINEINOGO VZAIMODEISTVIYA VOLN V PLAZME]
G. M. Zaslavskii 1966 10 p refs In RUSSIAN
(IIF-LA-6)

The dynamic equations describing the nonlinear interaction of small-amplitude waves in plasma with discrete spectra were examined. The conditions under which the random phase approximation was correct were obtained. The criterion depends on the form of the spectrum, the wave amplitude, and the distance between harmonics in the spectrum. It is shown that in the limiting case of a continuous spectrum, the random phase criterion was reached automatically. The boundary of the wave spectrum for which the kinetic equations are applicable is given. Author (NSA)

N68-22547# Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki.
INSTABILITY OF PLASMA WITH VARIOUS DEGREES OF NON-HOMOGENEITY [NEUSTOICHIVOST' PLAZMY S PAZLICHNOI STEPEN'YU NEODNORODNOSTI]
N. S. Buchel'nikova, R. A. Salimov, and Yu. I. Eidel'man 1967 20 p refs In RUSSIAN
(IIF-LA-9)

The instability of nonhomogeneous plasma during change of the degree of nonhomogeneity was investigated. It is shown that in slightly nonhomogeneous plasma drift waves are excited, changing over in the case of strong nonhomogeneity to azimuthal ion–sound waves. The state of the plasma and the diffusion across the magnetic field with various ion–sound instability is discussed. Author (NSA)

N68-22554 California Univ., Los Angeles.
THE KINETIC EQUATION FOR AN UNSTABLE PLASMA IN STRONG, PARALLEL, DC ELECTRIC AND MAGNETIC FIELDS AND PLASMA STREAMING INTO A TRANSVERSE MAGNETIC FIELD
Sidney Leonard Ossakow (Ph.D. Thesis) 1966 120 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-5990

In Part I of this dissertation, the response of a homogeneous plasma, in a strong uniform magnetic field, B_0, to the sudden application of a strong, uniform electric field is studied in a self-consistent formulation which treats the coupled equations for the one-particle and two-particle distribution functions resulting from neglect of three-particle correlations. The basic goal of Part II of this dissertation is to solve the simplest time-independent boundary value problem of a plasma streaming into a transverse magnetic field, in a quasi-linear fashion, starting from first principles. The first problem discussed is that of a cold plasma slab, of thickness d $<< \sqrt{r_{ce} r_{ci}}$ the geometric mean of electron and ion cyclotron radii. The second problem considered is the region to the right of the slab, in which there is relative electron-ion streaming in the y direction but no external magnetic field. Author

N68-22704# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Groupe de Recherches de l'Association EURATOM.
CALCULATION METHOD OF THE DISPERSION RELATION OF A HOMOGENEOUS PLASMA [METHODE DE CALCUL DE LA RELATION DE DISPERSION D'UN PLASMA COLLISIONNEL]
Charles Lafleur Dec. 1967 8 p refs In FRENCH
(CEA-R-3413; EUR3585.F) CFSTI: HC $3.00/MF $0.65

Starting from kinetic equations derived from the Fokker–Planck term introduced by Chandrasekhar, the dispersion relation of a homogeneous plasma is obtained easily through the use of a convenient set of eigenvalue functions. Author

N68-22708*# Case Inst. of Tech., Cleveland, Ohio.
RADIATION FROM SOURCES IMMERSED IN A PARTLY IONIZED GAS
Denis J. Connolly [1968] 55 p refs
(Grant NSG-198)
(NASA-CR-94598; A-41) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Using a three fluid model, wave equations are developed for the disturbances due to current or hydrodynamic force sources in a plasma. The formal solutions to the wave equations are obtained for an elementary current source. The power radiated from the source is given in terms of these solutions and, for the special case in which the electrons are much hotter than the other two constituents, the radiated power is determined in detail. Author

N68-22710# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
INVESTIGATIONS OF UNIVERSAL PLASMA INSTABILITIES Quarterly Report, 1 Jun.–31 Aug. 1967
31 Aug. 1967 9 p
(Contract AT(40-1)-3405)
(ORO-3405-17; QR-7) CFSTI: HC $3.00/MF $0.65

A preliminary investigation was made of the electron bombardment system for the University of Maryland Q device. A summary of the motivation, design considerations, and the results of preliminary tests of this bombardment diode are given. NSA

N68-22711*# Case Inst. of Tech., Cleveland, Ohio.
SIMILARITY STUDIES ON THE RADIATIVE GAS DYNAMIC EQUATIONS
James Ni Castro 1968 151 p refs
(Grant NsG-198)
(NASA-CR-94409; A-47) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Spherically symmetric similarity solutions of radiative gas dynamic equations are examined for problems of imploding and exploding shock waves. The system is reduced to a similarity form by retaining the definitions of the radiant quantities as operators on the radiative intensity. Homology structure for the intensity is dictated by the governing equations. It is shown that stipulating a radiative transfer law constitutes a simple constraint on the system. Large classes of radiative transfer laws are compatible with a constant shock strength or with a limitingly strong shock. Because of radiative heating, similarity structure may be prescribed for the gas upstream as well as down-stream of the shock wave. Constant shock strength is maintained by virtue of identical similarity homology in both regions. The general Rankine–Hugoniot equations for an arbitrary radiative intensity and initial conditions appropriate to self similar motion are given. It is shown that a sequential procedure for numerical solutions can be established. In the adiabatic problem, the solution for the velocity distribution is not contingent on the form of the radiative intensity. Useful approximation schemes are illustrated. Author

N68-22731# United Kingdom Atomic Energy Authority, Culham (England).

COMPUTED DATA FOR PHOENIX 2: PLASMA DENSITY AND VELOCITY DISTRIBUTIONS, SINGLE PARTICLE BEHAVIOUR, AND DETECTOR EFFICIENCIES

G. Kuo-Petravic, M. Petravic, A. C. Riviere, C. A. Steed, and D. R. Sweetman Sep. 1967 22 p refs
(CLM-R-76) CFSTI: HC$3.00/MF$0.65

The advent of complex field configurations to produce magnetic wells has made desirable a simple method of describing the plasma distribution. One such method is described which essentially gives the plasma distribution in terms of the axial adiabatic invariant (J) and the precessional drift surface described by the radius of a flux tube. Plasma distributions in this two dimensional space are plotted for typical Phoenix-II injection conditions and, using similar computer programs, the efficiency of neutral particle emission detectors is calculated. Other properties such as the average anisotropy and precessional drift frequency have been computed. Author (NSA)

N68-22736# Laboratoire de Recherches Sur la Physique des Plasmas, Lausanne (Switzerland).

MEASUREMENT OF ELECTRONIC DENSITY IN A PINCH WITH A FIELD ROTATING AT HIGH FREQUENCY [MESURES DE LA DENSITE ELECTRONIQUE DANS UNE STRICTION A CHAMP TOURNANT A HAUTE FREQUENCE]

A. Heym Dec. 1967 14 p refs In FRENCH Sponsored by le Fonds Natl. Suisse de la Rech. Sci.
(LRP-36/67)

Two high-power generators deliver rf pulses, each of which consists of 8 periods at a frequency of 2 MC. In a tube of 5-cm diameter and 50-cm length, one generator produces an axial current of 18-kA peak amplitude while the other, which feeds a 3-turn coil, induces an azimuthal current of 56-kA peak amplitude in the plasma. When the two currents are dephased by 90°, the plasma experiences a rotating magnetic field of 1.8 kG. Axial streak pictures of the plasma were taken, and the temporal and spatial variations of the electron line density were measured with a Mach–Zehnder interferometer. This apparatus is equipped with a photomultiplier detection system which allows the electron line density to be measured without ambiguity. The sensitivity of the device is approximately 5×10^{13} cm^{-3}. These measurements were made in 25-mtorr He which was preionized by an axial current pulse of 13-kA amplitude and 15-μsec duration. The formation of a pinch is demonstrated. The electron density on the axis of the discharge tube grows during the first two microseconds until the value of 1.15×10^{16} cm^{-3} is reached. At this time the density within 4 mm of the wall is lower than 5×10^{13} cm^{-3} and the integral of the electron density over the cross section indicates complete ionization. After about 2.5 μsec the current returns to the wall. Simultaneously evolution of gas from the wall is observed. The possible correlation of these two phenomena is discussed. Author (NSA)

N68-22739# Laboratoire de Recherches sur la Physique des Plasmas, Lausanne (Switzerland).

APPARATUS FOR MEASURING THE PROPERTIES OF A ROTATING MAGNETIC FIELD [APPAREIL DE MESURE DES PROPRIETES D'UN CHAMP MAGNETIQUE TOURNANT]

I. R. Jones, J-M. Peiry, and D. Cocq Dec. 1967 36 p refs In FRENCH Sponsored by le Fonds Natl. Suisse de la Rech. Sci.
(LRP-35/67)

An apparatus is described which allows one to measure the properties of a rotating magnetic field. This apparatus is used to monitor the field during the formation of a rotating field pinch. Author

N68-22750# California Univ., Livermore. Lawrence Radiation Lab.

MULTICOMPONENT PLASMA INSTABILITIES

L. D. Pearlstein 9 Jan. 1968 12 p refs Presented at Intern. Conf. on Plasma Confined in Open-Ended Geometry, Gatlinburg, Tenn., 1–3 Nov. 1967
(Contract W-7405-ENG-48)
(UCRL-70665; CONF-671127-2) CFSTI: HC$3.00/MF$0.65

High-frequency stability of multicomponent plasmas is reviewed for two distinct modes. In both cases, the equilibrium consists of a high-temperature anisotropic or loss-cone limited plasma superimposed upon a low-temperature background plasma. In one, the stability of flute-like ($k_{||} = 0$) electrostatic modes is examined. It is found that instability occurs at frequencies characteristic of electron (ion) gyrofrequencies and their harmonics, provided the species gyrofrequency (Ω) is less than the upper (lower) hybrid frequency (ω_{HY}) of the cold plasma. In this case, one finds instability if the fractional density of hot particles exceeds $(\Omega/\omega_{HY})^{1/2}$ for a small admixture of the hot plasma. In the opposite limit, instability occurs if the fractional density of cold particles exceeds $(T_C/T_H)^{3/2}$. In the second case, the $k_{||} = 0$ restriction is removed and it is found that the region of instability now includes $\Omega/\omega_{HY} > 1$. It is also found that for this mode the temperature anisotropy is not critical. Author (NSA)

N68-22801# Los Alamos Scientific Lab., N. Mex.

HYDROMAGNETIC EQUILIBRIUM OF A THIN-SKIN, FINITE-BETA TOROIDAL PLASMA COLUMN

J. L. Johnson, R. L. Morse, and W. B. Riesenfeld 11 Sep. 1967 18 p refs
(Contract W-7405-ENG-36)
(LA-3778) CFSTI: HC$3.00/MF$0.65

An analytic approach to describing the toroidal equilibrium of a finite-beta plasma column in the hydromagnetic approximation is presented. The thickness of the sheath region separating the plasma from the confining magnetic field is assumed to be negligibly small compared to all other dimensions (the "thin-skin" approximation). The deviations of this sharp interface from a toroidal cylinder shape are treated by perturbation theory, a procedure which is shown to be consistent with the usual series expansion in powers of recpirocal aspect ratio. This analytic formulation has the merit of providing engineering design estimates for the auxiliary external current strengths required in a toroidal theta-pinch device (Scyllac) to compensate for toroidal drifts and provide an equilibrium configuration for a finite-beta plasma. The auxiliary fields are superpositions of azimuthally modulated multipole fields applied in addition to an azimuthal modulation component of the main toroidally directed theta-pinch field. It is shown that the presence of this latter component is necessary for a convergent superposition. Author (NSA)

N68-22803# Laboratoire de Recherches sur la Physique des Plasmas, Lausanne (Switzerland).

MEASUREMENTS OF ELECTRON DENSITY IN A PRE-IONIZED AXIAL DISCHARGE BY MEANS OF AN IMPROVED SPECTROMETER [MESURES DE DENSITE ELECTRONIQUE DANS UNE DECHARGE AXIALE DE PREIONISATION A L'AIDE D'UN INTERFEROMETRE AMELIORE]

A. Heym Nov. 1967 18 p refs In FRENCH Sponsored by le Fonds Natl. Suisse de la Rech. Sci.
(LRP-33/67)

A Mach–Zehnder interferometer is described which is used for electron line density measurements of a rapidly varying plasma. The density profile of the plasma is obtained by scanning a 3-mm-wide He–Ne laser beam across the diameter of the discharge tube. Fringe detection is made with a system of two photomultipliers which allows one to follow the sense of variation of the electron line density in an unambiguous manner. This interferometer is used to measure the electron line density of an axial current discharge in 25 mtorr H_2. Complete ionization of the gas is found after 9 μsec. The gas remains in a fully ionized state until the discharge current is crowbarred. Electron loss is observed to be governed by ambipolar diffusion for time greater than 10 μsec after crowbar.
Author (NSA)

N68-22847*# Gulf General Atomic, San Diego, Calif.

EXPERIMENTAL INVESTIGATION OF THE FUNDAMENTAL MODES OF A COLLISIONLESS PLASMA Final Report, 10 Mar. 1964–31 Oct. 1967

John H. Malmberg, Dilip K. Bhadra, David L. Book, C. David Moore, L. Donald Pearlstein et al 23 Nov. 1967 129 p ref
(Contract NAS7-275)
(NASA-CR-94430; GA-8375) CFSTI: HC$3.00/MF$0.65 CSCL 20I

This report summarizes results of experimental and theoretical research to investigate propagation of electron cyclotron waves in a collisionless plasma and to investigate the origin and effects of low frequency noise in the plasma. The theoretical work concentrates on the application of the linear theory of plasma waves to geometries encountered experimentally, where the size is finite, and the density is a function of position. A perturbation method is derived for predicting the Landau damping (or growth) of electron cyclotron waves in terms of the electron velocity distribution function and the potential and density profiles. The dispersion, damping, and beam induced growth of the waves have been measured as a function of the plasma parameters and the plasma boundary conditions. The results are compared to theory. An electronic device for analyzing composite interferograms composed of two or more damped sine waves is described. Measurements on the origin and effects of low frequency noise in the plasma (10–300 kc) are presented. Methods are given for reducing the low frequency noise which result in a simultaneous order-of-magnitude reduction in anomalous diffusion of the plasma.
Author

N68-22854*# Case Western Reserve Univ., Cleveland, Ohio.

AN EXPERIMENTAL INVESTIGATION OF SHOCK WAVES IN HIGHLY IONIZED HELIUM

George L. Spencer Jun. 1966 83 p refs
(Grant NsG-198)
(NASA-CR-94395; A-43) CFSTI: HC$3.00/MF$0.65 CSCL 20I

An experimental investigation of shock waves moving through a highly ionized gas is reported. The shock waves are generated in an electromagnetic T-tube. The ambient gas, helium, is highly preionized by means of an axial current discharge with the shock waves being initiated during the after-glow period of the preionization. Measurements have shown that the plasma is in local thermal equilibrium and nearly completely ionized during the early after-glow period of the preionization. Typical temperatures and electron densities are in the order of 22,000°K and 3×10^{16} electrons/cm^3. Gasdynamic shock waves were studied and the results compared to the theory presented by Jaffrin and Probstein. It was possible to verify the existence of, and quantitatively measure the thickness of the first layer, as predicted by their theory. Magnetohydrodynamic effects were studied via provision of an axial magnetic field. Magnetic field jumps and currents were observed in the shock front and found to be completely stable as long as the shock waves could be observed. It was found that these effects did not appear if either the applied magnetic field or preionization were absent.
Author

N68-22887*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PERIODIC, SMALL-AMPLITUDE SOLUTIONS TO THE SPATIALLY UNIFORM PLASMA CONTINUITY EQUATIONS

J. Reece Roth Washington May 1968 43 p refs
(NASA-TN-D-4472) CFSTI: HC$3.00/MF$0.65 CSCL 20I

The coupled set of first-order nonlinear differential equations $\dot{\chi} = C_0 + C_1\chi + C_2 y + C_3\chi y + C_4\chi^2 + C_5 y^2$ and $\dot{y} = A_0 + A_1\chi + A_2 y + A_3\chi y + A_4\chi^2 + A_5 y^2$ are solved by an approximate method which gives y(t) in closed form for the particular case in which the variables χ and y vary periodically in time, the coefficients C_i and A_i are real, and the peak-to-peak variation of χ is of small amplitude relative to the mean value of χ. The peak-to-peak amplitude of y, however, is not necessarily small compared with the mean value of y. These equations are a generalized form of Volterra's problem of two conflicting populations, in which χ is the population density of the prey, and y is the population density of the predator, or vice versa. Similar equations may also be derived from the spatially uniform neutral and charged-particle continuity equations in the field of plasma physics. These equations then describe relatively low-frequency oscillations in the number density of electrons and neutral atoms in a partially ionized plasma.
Author

N68-22897# Maryland Univ., College Park. Dept. of Physics and Astronomy.

APPLICATIONS OF LIGHT SCATTERING TO PLASMA DIAGNOSTICS Progress Report

Hans R. Griem Dec. 1967 86 p refs
(Contract AT(40-1)-3393)
(ORO-3393-3) CFSTI: HC$3.00/MF$0.65

Six sections are included: (1) A description of the low field, large volume theta pinch on which most of the light scattering and spectroscopic experiments have been performed; (2) A preprint of a paper to appear in The Physical Review on measured collisional rate coefficients for helium-like carbon ions; (3) A preprint of a paper to appear in The Physics of Fluids on the determination of electron temperatures and densities from helium-like ion line emission; (4) A note on impurity determinations; (5) A note on operation with low pressure methane fillings; (6) A status report for the high electron density–low temperature light scattering experiment.
Author (NSA)

N68-22920# Cornell Aeronautical Lab., Inc., Buffalo, N. Y. Aerodynamics Research Dept.

EXPERIMENTAL STUDY OF ELECTRICAL CURRENTS TO A FLAT PLATE IN A FLOWING, WEAKLY IONIZED GAS

A. F. Burke Sep. 1967 15 p refs Presented at AIAA 6th Aerospace Sci. Meeting, Plasma Dyn. Session, Jan. 1968 Prepared for Sandia Corp., Albuquerque, N. Mex.
(Contract AT(29-1)-789)
(SC-DC-67-2052; CONF-680101-3) CFSTI: HC$3.00/MF$0.65

An experimental study of electrical currents to a flat plate in a flowing plasma was conducted using the gas behind the incident shock in a shock tube as the test medium. Theoretical comparisons were made with the data.
NSA

N68-22998# Commissariat a l'Energie Atomique, Saclay (France).

CHRONOLOGICAL STUDY OF BERYLLIUM PLASMA PRODUCED BY A LASER BEAM [ETUDE CHRONOLOGIQUE DU PLASMA DE BERYLLIUM CREE PAR LE FAISCEAU D'UN LASER]

Philippe Langer, Gianfranco Tonon, Yves Durand, and Jean-Claude Buges Dec. 1967 60 p refs In FRENCH; ENGLISH summary
(CEA-R-3296) CFSTI: HC$3.00/MF$0.65

We have carried out several investigations (ultra-rapid cinematography, visible and ultra-violet spectroscopy, interferometry, charged particle detection) on beryllium plasma produced by a ruby laser. The plasma, visible from −60ns, undergoes a uniform acceleration from −30 to +5 nanoseconds; at this moment its velocity reaches a value of 10^7 cm/sec. Be^+, Be^{2+} and Be^{3+} ions are emitted by the plasma as soon as it is formed and have a maximum kinetic energy of 1,500 eV. The spectroscopic study of the plasma has shown the appearance of recombination lines of ionized beryllium and of lines of excited beryllium at +70 nanoseconds and +120 nanoseconds respectively. These lines are still visible after +470 and +720 nanoseconds. Interferometric measurements carried out on this plasma have shown that its electronic density is not uniform and decreases rapidly at increasing distance from the target. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N68-21868*# National Bureau of Standards, Boulder, Colo.

SURVEY OF ELECTRICAL RESISTIVITY MEASUREMENTS ON 16 PURE METALS IN THE TEMPERATURE RANGE 0 TO 273°K

L. A. Hall Feb. 1968 113 p refs
(NASA Order R-06-006-046)
(NASA-CR-94169; NBS-TN-365) GPO: HC $0.60; CFSTI: MF $0.65 CSCL 20L

Experimental electrical resistivity data for 16 pure metals have been compiled, tabulated, and graphically illustrated for a temperature range of 0 to 273°K. A section has been prepared for each particular metal which includes references, brief comments concerned with preparation of sample, purity, and any other pertinent information, tabulated data, and graph. Author

N68-21887 Northwestern Univ., Evanston, Ill.

INTERDIFFUSION IN SILVER–GOLD SOLID SOLUTIONS AT LOW TEMPERATURES

Harry Edgar Cook (Ph.D. Thesis) 1966 134 p
Available from Univ. Microfilms: HC $6.40/MF $3.00 Order No. 67-4212

Diffusion over very short penetration distances was studied in the Ag–Au system in order to test the validity of the diffusion equation $(\partial c_n/\partial t) = (\tilde{D}/d^2)[\Delta^2 c_n - (2\kappa/f''d^2)\Delta^4 c_n]$ in which c_n is the concentration of the second component on the n^th^ lattice plane, d is the planar spacing, f″ the second derivative with respect to composition, κ is the gradient-energy coefficient and $\tilde{D}$ an interdiffusion coefficient defined by $\tilde{D} = [c(1-c)/f''N_v kT]\,[cD_1^* + (1-c)D_2^*]$ where N_v is the number of atoms per unit volume and D_1^* and D_2^* are tracer diffusivities. Diffusion specimens having penetration distances between 7 and 35Å were prepared by evaporating alternating layers of metals onto a mica substrate. The diffracted x-ray intensity of the specimens showed satellites whose intensity was proportional to the square of the amplitudes of the Fourier components of the composition modulation. Dissert. Abstr.

N68-21914 Stanford Univ., Calif.

A POINT-CONTACT METHOD FOR DETERMINING THE CHARGE CARRIER DENSITY AND MOBILITY IN THIN SEMICONDUCTING LAYERS

Martin Geroge Buehler (Ph.D. Thesis) 1966 66 p
Available from Univ. Microfilms: HC $3.80/MF $3.00 Order No. 67-4328

The "Hall four-point probe" developed here consists of a square array of point contacts centered on a thin circular sample with a perpendicular magnetic field. It is useful for the quick and routine measurement of the resistivity and the Hall coefficient. This method is unique in that the Hall effect is measured using four contacts which do not lie on the edge of a sample. This problem is solved by a new theory, and the result is expressed in terms of resistivity and Hall correction factors. The new theory, used to find correction factors for all Hall four-point probe, is applicable to other two-dimensional problems such as rectangular or infinite half-plane configurations. The main result of the new theory, which is a method of images, is that the potentials near point sources, sinks, and images have an expected $-\ln r$ radial dependence. Near some images, however, the potentials have an additional angular dependence. It is the angular dependence of image potentials which produces the Hall effect in the two-dimensional configurations solved by this theory. Dissert. Abstr.

N68-21945 Pittsburgh Univ., Pa.

NUCLEAR MAGNETIC AND ELECTRON PARAMAGNETIC RESONANCE CALCULATIONS

Sandra Ann Gade (Ph.D. Thesis) 1966 127 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-4565

A theoretical formula is derived for the free induction decay of a system of identical particles of spin I. The computations show that the free induction decay shape is remarkably insensitive to the value of I. The spin diffusion equation is derived by considering the equation of motion of the spin density matrix after transforming to an interaction representation. For spins arranged in a simple cubic lattice, an average diffusion constant, $\bar{D}$, is defined and evaluated for the following three directions of the externally applied magnetic field: [100], [110] and [111]. A model for the A centers in germanium-doped quartz is presented, which agrees reasonably well with the experimental data. The symmetry properties of the anisotropic part of the magnetic dipole–dipole interaction are found for the physical situation where one magnetic dipole is a point dipole and the other dipole has a spatial distribution given by a real spherical harmonic, which may or may not be centered on the point dipole. Dissert. Abstr.

N68-21957 New Mexico Univ., Albuquerque.

A GENERAL APPROACH TO THE ANALYSIS OF PARTICLE TRANSPORT IN SOLIDS; WITH PARTICULAR APPLICATION TO HIGH FREQUENCY EFFECTS ON CHARGE TRANSPORT IN SEMICONDUCTOR DEVICES

Raymond Allen Gore (Ph.D. Thesis) 1966 103 p
Available from Univ. Microfilms: HC $8.40/MF $3.00 Order No. 67-6236

The purpose of this dissertation is to develop from transport theory, based on the assumed knowledge of the particle-medium interaction characteristics, equations which do not possess the limitations of diffusion theory, and hence, provide an accurate description of the transport process in small size and high frequency semiconductor devices. The describing equations obtained are of the transmission line variety, being coupled, first-order, partial differential equations involving the particle current density and the particle density. These equations lead to second-order differential equations of the telegrapher type for each of the two variables. The necessary descriptive equations for the transport process are derived, then solutions and models of the equations are obtained. The formulation presented here is general enough to describe many of the particle transport problems in solids, but particular application has been made to the analysis of charge transport in semiconductors. Dissert. Abstr.

N68-21959 Ohio State Univ., Columbus.

ELECTRONIC CONDUCTION IN TWO SOLID OXIDE MIXED CONDUCTORS

John William Patterson (Ph.D. Thesis) 1966 110 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-6354

An experimental technique for measuring high temperature electronic conduction in the predominantly ionic conductors $Zr_{0.85}Ca_{0.15}O_{1.85}$ and $Th_{0.85}Y_{0.15}O_{1.925}$ is developed and described in detail. A significantly improved technique for analyzing the resulting data is also developed and then employed to simultaneously deduce both excess electron and electron hole conductivities from data obtained by the experiment. The results of this investigation provide the first direct measurements of electron and hole conduction for the above oxides at elevated temperatures and are used to establish the pertinent defect structures as well as the limitations of these materials as electrolytes in solid state galvanic cells. Dissert. Abstr.

N68-21964 Stanford Univ., Calif.

ELASTIC RADIATION FROM A PROPAGATING PHASE BOUNDARY

Geoffrey Burwell Holstrom (Ph.D. Thesis) 1966 99 p
Available from Univ. Microfilms: HC $5.00/MF $3.00 Order No. 67-4365

The possibility of generating growing elastic waves from the release of internal strain in a solid is considered. Internal strain is divided into two parts: a real part due to dislocations, and a frozen part which is present if the body is metastable and subject to alteration of crystal structure. Real internal strain can be created in a body by displacing adjacent parts of a cut in opposite directions and then rewelding the cut. The resulting distortion is the real internal field. Frozen strain can be present in an undeformed body when that body is not in thermodynamic equilibrium. In such a case there exists a potential to deform at every point by change of crystal structure. These concepts of internal strain are applied to the propagation of a polymorphic phase boundary. A linearized classical model for the process is devised and equations describing its operation are obtained. Dissert. Abstr.

N68-22092 Illinois Univ., Urbana.

ABSORPTION AND LUMINESCENT EXCITATION SPECTRA OF F AND M CENTERS IN KCl AND NaF

James Leroy Boettler (Ph.D. Thesis) 1966 178 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-6562

Luminescent excitation spectra were measured for the F and M centers in KCl; in particular, for the F band, M band, and the M_2 transition. In all 3 cases, the spectra were nearly double-Gaussian in shape, and the efficiency for luminescence was nearly independent of the wavelength of the exciting light. A comparison of the absorption spectrum with the excitation spectrum of the F-band region of crystals with M centers present and oriented provided further evidence for the existence of the M_2 transition of van Doorn and Haven and of Okamoto, and against the energy-transfer theory of Lambe and Compton. In NaF crystals having no absorption bands to the red side of the M band, the absorption and excitation spectra of the M band were accurately double-Gaussian over a wide range of wavelengths; the efficiency of luminescence of the M center was independent of the wavelength of the exciting light in that range; and the polarization of luminescence upon M-band excitation agreed well with the calculations based on the van Doorn–Haven model of the M center. Dissert. Abstr.

N68-22111*# Stanford Univ., Calif. Solid State Electronics Labs.

FUNDAMENTAL STUDIES OF THE METALLURGICAL, ELECTRICAL, AND OPTICAL PROPERTIES OF GALLIUM PHOSPHIDE **Quarterly Progress Report, 1 Jan.–31 Mar. 1968**

Gerald L. Pearson 31 Mar. 1968 17 p refs
(Grant NsG-555)
(NASA-CR-94308) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The following studies are reported: (1) *The Properties of Rectifying junctions in* $GaAs_xP_{1-x}$—relationship between junction depth, temperature, and phosphorus pressure on p–n junctions formed by zinc diffusion into n-type gallium; (2) *Semiconductor Devices for High Temperature Use*—improvement of Ni:n-GaP Schottky diodes by increasing their reverse breakdown voltage as well as decreasing their forward resistance through doping with tin; and (3) *Donor Impurities in GaP*—the behavior of sulfur, selenium, and tellurium diffused into gallium phosphide crystals. G.G.

N68-22119 California Univ., Berkeley.

SURFACE IONIZATION OF CESIUM AND THERMIONIC EMISSION FROM PLANAR SINGLE CRYSTALS OF TUNGSTEN

Daniel René Koenig (Ph.D. Thesis) 1966 300 p
Available from Univ. Microfilms: HC $13.50/MF $3.85 Order No. 67-5097

The thermal emission of electrons, and cesium atoms and ions from two large (≈1.5 cm²), flat, monocrystalline, tungsten surfaces oriented in the [100] and [110] crystallographic directions was investigated. All experimental results were obtained by measuring the current-voltage-time characteristics of two diodes, each having one of the tungsten single crystals for the cathode (emitter). A guard ring in the plane of the collector insured accuracy of the current measurements. The change in the work function of each crystal surface due to adsorption of cesium was evaluated from measurements of both the field-free electron and cesium-ion emissions in the surface-temperature range 850 to 1450°K and the cesium-reservoir temperature range 0 to 100°C. As part of this study, the flux of cesium vapor in equilibrium with its condensed phase was measured in the temperature range 0 to 120°C. Dissert. Abstr.

N68-22121 Florida Univ., Gainesville.

A STUDY OF SECOND-ORDER, [1011]–[1012] TWINNING IN MAGNESIUM

William Handy Hartt, III (Ph.D. Thesis) 1966 255 p
Available from Univ. Microfilms: HC $10.15/MF $3.00 Order No. 67-3478

Single crystals of high purity magnesium, oriented with the basal plane parallel to the stress axis, were deformed in tension at room temperature and at a strain rate of 0.002 inches/inch/min. in order to form second-order, $\{10\bar{1}1\}$–$\{10\bar{1}2\}$ twins. The structure and properties of these twins were then investigated using optical and replica electron microscopy techniques. It was concluded that three basic features of these twins are of major importance. The first concerns the fact that $\{10\bar{1}1\}$–$\{10\bar{1}2\}$ twins are inclined approximately 56° to the matrix basal plane, while the orientation of a coherent, $\{10\bar{1}1\}$ twin boundary is at 61°54'. This indicates that a habit shift occurs at some point of the second-order twinning operation. The second features concerns the extensive internal deformation which may occur after the twins form. Experimental observations indicate that after this deformation the basal plane within the second-order twin is oriented nearly parallel to the twin boundary. The third feature concerns the fracture which occurs at these twins. This is attributed to large, shear strains which develop in these regions. Dissert. Abstr.

N68-22128 Temple Univ., Philadelphia, Pa.

COHESIVE ENERGY OF THE NOBLE METALS

Irwin Mark Pikus (Ph.D. Thesis) 1966 175 p
Available from Univ. Microfilms: HC $8.00/MF $3.00 Order No. 67-3220

The present theory of metallic cohesion is examined and certain inadequacies, especially with regard to the case of the noble metals, are pointed out. Previous calculations of cohesion in the noble metals are reviewed. The chief deficiency is shown to be in the treatment of the d-electrons. These electrons are not amenable to treatment as either valence electrons or as tightly bound ion core electrons. A model for the d-electron interactions is hypothesized and tested by calculating the cohesive energy, equilibrium lattice constant, compressibility and energy difference between fcc and bcc structures for the noble metals. Dissert. Abstr.

N68-22135 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BREAKDOWN OF DIELECTRICS AND SEMICONDUCTORS

30 Aug. 1967 14 p refs Transl. into ENGLISH from the Publ. "Proboy Dielektrikov i Poluprovodnikov. Sbornik Dokladov 4 Mezhvuzovskoy Konferentsii po Proboyu Dielektrikov i Poluprovodnikov" Moscow, Energiya Publishing House, 1964 p 174–176, 195–197, and 319–322
(FTD-MT-24-148-67; AD-666154)

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N68-22136 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF THE ELECTRICAL BREAKDOWN OF THIN LAYERS OF ORGANIC GLASS AND CELLULOID [ISSLEDOVANIYE ELEKTRICHESKOGO PROBOYA TONKIKH SLOEV ORGANICHESKOGO STEKLA I TSELLULOIDA]

V. A. Kostrygin *In its* Breakdown of Dielec. and Semicond. 30 Aug. 1967 p 1–4 refs (See N68-22135 12-26)

The final stage of breakdown is studied, and data are obtained concerning the energy liberated in the spark channel, the specific electric characteristics of the spark channel, and the expansion of the spark channel. According to oscillograms of the voltage and current obtained in the breakdown of a rock salt single crystal, the energy liberated in the spark channel by the given moment of time was calculated as a function of the magnitude of the penetrating voltage and parameters of the discharge circuit. The ohmic resistance of the discharge gap after a few dozen nanosec decreases from hundreds of ohms to a magnitude depending upon the inductivity of the circuit and U_{tre} In the table, the change in the radius of the spark channel r, current i, current density j, specific conductivity σ, specific energy W are shown in the breakdown of a single crystal 1 cm thick. The average rate of expansion of the channel is equal to 1.4×10^5 cm/sec. The temperature of the spark channel in breakdown of rock salt specimens 1 cm thick was calculated on the basis of Wien's bias law. Author

N68-22137 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PHYSICAL PROCESSES IN THE FINAL STAGE OF BREAKDOWN OF SOLID DIELECTRICS [FIZICHESKIKH PROTSESSAKH V ZAVERSHAYUSHCHEY STADII PROBAYA TVERDYKH DIELEKTRIKOV]

V. I. Obukhov *In its* Breakdown of Dielec. and Semicond. 30 Aug. 1967 p 5–8 refs (See N68-22135 12-26)

An experimental investigation was performed on the dc- and pulsed-voltage breakdown (rectangular pulses with a front duration of $\approx 5.10^{-8}$ sec and excess voltage of 7.5–10%) of an organic glass (5–16)·10^{-4} cm thick and celluloid (6–30)·10^{-4} cm thick. The effect of the strengthening and increased time to breakdown at small thicknesses of dielectrics of amorphous and crystalline structure indicates the presence of impact ionization during breakdown. Emphasis is placed on the importance of studying the question of the strengthening of thin films for the development of microminiature devices, in particular film capacitors which have high electrical strength in addition to high capacitance. Author

N68-22138 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ELECTRICAL STRENGTH OF OXIDE FILMS ON ALUMINUM [ELEKTRICHESKAYA PROCHNOST' OKSIDNYKH PLENOK NA ALYUMINII]

L. L. Odynets, F. S. Platonov, and P. A. Raykerus *In its* Breakdown of Dielec. and Semicond. 30 Aug. 1967 p 9–14 refs (See N68-22135 12-26)

The elec. breakdown was studied for oxide films obtained on Al by electrochem. oxidn. in an aq. soln. of boric acid and borax at 85°. The elec. breakdown voltage was measured as a function of the film thickness (0–1.25μ) by using spheres of steel, Cu, Hg, and Al as the 2nd electrode. The dielec. strength of the films depended on the state of the electrode surface but not on its nature. For nonmetallic electrodes, it was dependent of the material of the electrode. For very thin films (<0.3μ), an increase is observed in the dielec. strength as the thickness is decreased. The detg. stage in the breakdown is the development of impact ionization. For thicker films the detg. stage is the injection of electrons from the cathode into the conduction band of the dielec. Author

N68-22139 Iowa State Univ. of Science and Technology, Ames.

LANDAU SPECTRUM AND LINE BROADENING IN REAL METALS

Lloyd Craig Davis (Ph.D. Thesis) 1966 63 p
(Contract W-7405-ENG-82)
(IS-T-111) Available from Univ. Microfilms: HC $3.60/MF $3.00 Order No. 67-5579

The energy spectrum and level broadening of conduction electrons in the presence of a uniform magnetic field has been studied within the framework of the effective Hamiltonian formalism. A simple model which demonstrates the important ideas involved has been chosen. By using connection formulas which are accurate for all energies, we have shown how the degeneracies among the WKB solutions in different zones in reciprocal space are removed. These connection formulas were expressed in terms of a transmission and a reflection amplitude. It has been found that the Landau levels are given accurately by the Onsager rules and are essentially discrete except in the immediate vicinity of open orbits. Dissert. Abstr.

N68-22147 British Columbia Univ., Vancouver.

ESR—STUDY OF THE BANDSTRUCTURE OF CADMIUM SULFIDE

Bjoern Johan Slagsvold (Ph.D. Thesis) 1966 63 p
Available from Natl. Library of Can. at Ottawa: MF$1.00

The electronic g-tensor in halogen-doped cadmium sulfide was measured at 1.7°K, and its dependence upon uniaxial pressures parallel and perpendicular to the c-axis was investigated. A sample doped with iodine to a room temperature resistivity of ≈0.7 Ω cm exhibited an anisotropic g-tensor with $g_{\parallel} = 1.785$ and $g_{\perp} = 1.767$. The anisotropy in a heavily bromine-doped sample ($\rho \approx 0.07$ Ω cm) was the same, but $g_{\parallel}$ was slightly larger, 1.789. When some of the cadmium is replaced by zinc, the alloy acquires properties intermediate between those of CdS and ZnS. The pressure dependence of the g-tensor and the change in the optical bandgap under hydrostatic pressure could be reasonably well explained in terms of two deformation potential constants for the bandgap. Although the bandstructure of CdS is not sufficiently well known to predict the g-tensor correctly, the interaction of the conduction band with the valence bands appears to be dominant. Dissert. Abstr.

N68-22163 Princeton Univ., N. J.

THE EFFECT OF ELECTRON-HOLE SCATTERING RESONANCE ON X-RAY EMISSION SPECTRUM

Francis Kofi Ampeyin Allotey (Ph.D. Thesis) 1966 123 p

Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-5699

Soft X-ray emission of metals results when an electron in the conduction band makes a radiative transition to an inner hole of the atom. Effect of electron-hole scattering resonances on the soft X-ray emission spectra of metals has been studied, and a detailed theoretical calculation for the emission spectra of Li and Na. From a realistic quantitative calculation, the qualitative features of the observed K-emission spectrum of Li can be explained if a p scattering resonance exists in the band near the Fermi surface. The resonance is caused by the electron-hole scattering. Scattering wave functions for the electrons inside the Wigner–Seitz sphere were used to calculate the matrix elements. The emission spectrum of Li was computed for various effective masses. Our calculation shows that localized states do exist in the conduction band. Lack of localized state is given as the reason the emission spectra of other substances are normal. Dissert. Abstr.

N68-22205 Vanderbilt Univ., Nashville, Tenn.

THE AUGER, INTERNAL CONVERSION AND GAMMA-RAY SPECTRA FROM THE DECAY OF Pa^{233} AND AN INVESTIGATION OF THE EFFECT OF PHOTOELECTRON SCATTERING ON THE IEC METHOD

Michael Joseph Zender (Ph.D. Thesis) 1966 148 p

Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-4100

The purpose of this thesis is to provide some much needed experimental measurements of very low energy L-Auger and L-Coster–Kronig transitions, and to resolve discrepancies which have existed between previous experimental measurements of U^{233} internal conversion coefficients and theory. In addition, the new theoretical scattering corrections for the IEC f factor have been investigated experimentally at low energies as a function of converter thickness; and the electron "focusing effect" of the Vanderbilt post-accelerator geiger counter has been eliminated. Dissert. Abstr.

N68-22260 Stanford Univ., Calif.

NUCLEAR MAGNETIC SUSCEPTIBILITY OF A DILUTE SOLID MIXTURE OF He 4 IN He 3

Herbert Daniel Cohen (Ph.D. Thesis) 1966 103 p

Available from Univ. Microfilms: HC $5.20/MF $3.00 Order No. 67-4333

In order to study the departure of the susceptibility in solid mixtures from Curie–Weiss law behavior and the onset of nuclear spin ordering in solid He^3, an apparatus has been constructed which is potentially capable of reaching temperatures of the order of 1.5×10^{-3}°K by the serial adiabatic demagnetization of potassium chromium alum and copper nuclei. The apparatus is also capable of making susceptibility and relaxation time measurements both on the cool down and the warm up portions of the demagnetization cycle and of measuring the temperature of the sample lattice with a nuclear thermometer. Dissert. Abstr.

N68-22269 California Univ., Berkeley.

WORK FUNCTIONS OF MONOCRYSTALLINE AND POLYCRYSTALLINE RHENIUM

Ronald Wichner (Ph.D. Thesis) 1966 108 p

Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-5191

The bare work functions of polycrystalline rhenium and of the (1010), (1011) and (0001) orientations have been determined for planar emitters, in vacuum, at pressure of 2×10^{-10} to 7×10^{-9} Torr and in the temperature range, 1415°C–2021°C. Electron emission currents were obtained in a thermionic diode as a function of applied voltage, at a number of temperatures. The work functions were determined by means of the Richardson plot and also deduced from the position of the knee in the current-voltage characteristic. A guarded, single-crystal copper collector was employed in a plane geometry configuration in order to minimize edge and other non-uniform effects. A method was also developed for brazing the emitter buttons to tantalum support cups, using niobium as the high temperature braze material. Dissert. Abstr.

N68-22271*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AN EXPLANATION OF ANOMALOUS NON-HOOKEAN DEFORMATION OF IONIC SINGLE CRYSTALS

James P. Cusick and Donald R. Behrendt Washington May 1968 34 p refs

(NASA-TN-D-4513) CFSTI: HC$3.00/MF$0.65 CSCL 20L

Previously published non-Hookean load-deflection data are reviewed. The results of this review show that roughness of the sample loading surfaces contributes to the measured deflection. Simple calculations presented herein show the effect of surface roughness on load-deflection data. Experiments are described in which two simultaneous deflection measurements are made: one measures bulk sample deflections only, the other measures bulk and loading surface deflections. Non-Hookean effects are observed only when surface deflections are included in the measurement. Finally, microscopic surface examination reveals surface roughness of the size needed to produce the non-Hookean effect. The non-Hookean effects are a consequence of the experimental techniques and do not reflect the bulk properties of the sample. Author

N68-22278 British Columbia Univ., Vancouver.

EFFECT OF DEUTERATION ON THE NEEL TEMPERATURE OF $CoCl_2 \cdot 6H_2O$

Darshan Singh Sahri (Ph.D. Thesis) 1966 59 p

Available from Natl. Library of Can. at Ottawa: MF $1.00

The nuclear magnetic resonance technique has been used to study the effect of deuteration on the Neel temperature of $CoCl_2 \cdot 6H_2O$ single crystals. The Neel temperature varies with a period of 180° as the external magnetic field is rotated about the b-axis 1 and a-c plane. On deuteration, the Neel temperature rises for all orientations, the more deuterium being introduced the higher the transition point. The maximum increase of approximately 6% in Neel temperature is obtained with a 92% concentration of deuterium. In addition, the anisotropy in T_N decreases from approximately 0.08°K for 0% deuteration to slightly less than 0.05°K for 92% deuteration. Further, the orientation-averaged Neel temperature seems to vary linearly with the cube root of relative concentration of deuterium. Dissert. Abstr.

N68-22296 Northwestern Univ., Evanston, Ill.

ELECTRONIC DRIFT MOBILITIES AND SPACE-CHARGE-LIMITED CURRENTS IN LITHIUM-DOPED ZINC OXIDE

Martin Arthur Seitz (Ph.D. Thesis) 1966 155 p

Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-4268

The results of drift mobility and space-charge-limited current measurements made on single crystal, plane-parallel specimens of high-resistivity, lithium-doped zinc oxide have been interpreted using the band model of a semiconducting solid with imperfection levels in the forbidden energy region between the conduction band and valence band. The results of Hall mobility measurements made on single crystal specimens of low-resistivity, "pure" ZnO have been interpreted on the basis of a combination of impurity, acoustical and optical-mode scattering of charge carriers. Electron drift mobility and lifetimes were measured for the "a" and "c" crystallographic orientations in the 250° to 400°K temperature range by determining the time of transit of electrons across the specimen which had been photoinjected at one surface by light pulses of 10^{-8} second duration. The drift mobilities at 300°K ranged from 2 to 8 cm^2/volt-sec. for the specimens investigated. Dissert. Abstr.

N68-22323 Illinois Univ., Urbana.

A MAGNETIC RESONANCE STUDY OF THE SCREENING OF ELECTRIC FIELDS IN METALS

Nils Conard Fernelius (Ph.D. Thesis) 1966 146 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-6608

We have observed zero field resonance in zinc-doped aluminum samples by means of the Ramsey–Pound magnetic field cycling technique. Experiments were performed near 1.2°K in order to obtain T_1 sufficiently long to perform a cycle in a time less than T_1. The saturation of the 53.5 kc/sec resonance was analyzed with respect to impurity concentration and H_1 power level using the model of two coupled spin systems developed by R. T. Schumacher. This model views the power absorbed from the applied alternating field as absorbed by either the 53.5 kc/sec quadrupole resonance or by a system composed of nuclear moments in local magnetic fields with additional weak quadrupole splittings. A cross relaxation time was determined from the analysis which decreases with increasing impurity concentration. We made studies of the broadening of non-resonant spin absorption due to the weaker quadrupole splittings. Dissert. Abstr.

N68-22381# Royal Radar Establishment, Malvern (England).

POLAR CHARACTER OF ZINC OXIDE CRYSTALS. 2: ETCH PATTERNS ON PRISM FACES

Ansgar Klein May 1967 11 p refs Transl. into ENGLISH from Zeitung fur Physik (Germany), v. 188, 1965 p 352–360
(RRE-TRANS-174) CFSTI: HC $3.00/MF $0.65

A polar c-axis must be attributed to the wurtzite structure of zinc oxide. The sign of the x-axis can be determined by cleaving perpendicular to this axis and subsequent etching of the exposed (0001) surfaces. The present paper reports how this can be achieved without cleavage, merely by etching the prism faces (1010) which are the principal surfaces of hexagonal needles and of thin platelets. The etch patterns unambiguously point into the direction of the positive c-axis. The method is applied not only to the prism faces, but also to cleaved surfaces of the same orientation. A close relation between etch patterns and lattice defects is apparent. Author

N68-22406# Uppsala Univ. (Sweden).

HIGH-FIELD MOMENTUM DISTRIBUTION FUNCTION OF ELECTRONS IN GaAs

Bengt-Herman Forssen Jun. 1967 6 p refs
(UUIP-550)

The electron distribution function in GaAs was studied. An iterative numerical method was used. It is shown that the distribution function is strongly anisotropic in momentum space. Author (NSA)

N68-22427 Royal Radar Establishment, Malvern (England).

A NEW CLASS OF CRYSTALS FOR OQG WITH OPTICAL EXCITATION

Yu. K. Boron'ko, A. A. Kaminskii, and V. V. Osiko 1966 17 p refs Transl. into ENGLISH from Inorganic Mater. (USSR), v. 3, no. 7, 1966
(RRE-TRANS-182) CFSTI: $3.00

In this work some new results are produced from an investigation into the optical properties and the stimulated emission at 300 deg.K of a group of crystals of mixed fluorides with neodymium. Author

N68-22441# National Research of Canada, Ottawa (Ontario).

MEASUREMENT OF THE GROWTH RATE OF INDIVIDUAL FACES OF HEXAMETHYLENE TETRAMINE CRYSTALS [MESSUNG DER WACHSTUMGESCHWINDIGKEIT EINZELNER FLAECHER AN HEXAMETHYLENTETRAMIN-KRISTALLEN]

B. Honigmann and H. Heyer 1967 17 p refs Transl. into ENGLISH from Z. Krist. (Frankfurt am Main), v. 106, no. 3, 1955 p 199–212
(NRC-TT-1284) CFSTI: HC $3.00/MF $0.65

Hexamethylene tetramine single crystals are grown from the vapor phase. Growth at constant temperature and supersaturation is observed for several hours, during which the crystal increases a few millimeters in size. The crystals are photographed in the furnace every 15 minutes. In each case the growth rates of several 011 faces on the same crystal are determined from the photographs. As long as the crystal grows without perceptible defects, the growth rates of individual faces remain constant for a considerable time. They have different values, which sometimes change independently of each other; defects arising in the course of growth always result in a relatively intense increase in the growth rates of faces beset by such defects. Author

N68-22544# Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.

SOLID-STATE AND MOLECULAR THEORY GROUP

Quarterly Progress Report

15 Jan. 1968 41 p refs
(Contracts Nonr-1841(34); AF 19(628)-356; Grant NSF G-10821)
(QPR-67; AD-665963) CFSTI: HC $3.00/MF $0.65

Contents: Hartree-Fock vs. local-potential energy bands in KCl; Crystalline coulomb potential energy; Crystalline free-electron exchange potential energy; Molecular model for the localized electronic structure; Exchange potentials in gadolinium. TAB

N68-22568# Brookhaven National Lab., Upton, N. Y.

ANALYSIS OF IRIS-LOADED DEFLECTORS IN THE SMALL-HOLE APPROXIMATION

H. Hahn 5 Jan. 1968 19 p refs
(BNL-12143) CFSTI: HC $3.00/MF $0.65

The $\pi/2$ alternating periodic iris-loaded cavity is shown to be an ideal deflector for superconducting rf beam separators. Calculation of the shunt impedance of the iris-loaded deflector is based on the loose-coupling model, i.e., the deflector is represented as a chain of TM_{110} cavities, neglecting the perturbations due to the coupling holes. The dispersion diagram is derived by treating the deflector as a transmission line which is periodically loaded by shunt inductances. NSA

N68-22659# Illinois Univ., Urbana.

GROWTH OF TUNGSTEN CARBIDE MONOCRYSTALS

Alvin Phillip Gerk (M.S. Thesis) Feb. 1968 51 p refs
(Contract AT(11-1)-1198)
(COO-1198-501) CFSTI: HC $3.00/MF $0.65

In research conducted to produce large WC crystals it was found that the size and quality of crystals grown from Co solutions during controlled slow-cooling depend on the melt composition and cooling rate. For lower concentrations of WC, the crystals are larger but of poorer quality. Slower cooling rates produce larger crystals at any composition. WC monocrystals one centimeter in size can be grown by a modified Czochralski technique. Cobalt is an effective solvent metal for use with this technique. Aluminum oxide crucibles have been used to contain the WC-Co melts with satisfactory results, but a reaction occurs between the melt and the crucible. Growth seeds may contain grain boundaries if cobalt has been removed from these boundaries. The seeds must be at least 3/4 cm. in length, and the most favorable growth directions are the <0001> and <1100> directions. The quality of WC crystals is affected by the pulling temperature, melt composition, and the pulling and rotation rates used. The highest quality crystals have been obtained using high pulling temperatures with low concentrations of WC in Co. Slow pulling rates (under 0.001 in./hr) and fast rotation rates improve crystal quality. Evidence obtained during these experiments indicate that the eutectic point in the WC–Co vertical section of the W–C–Co ternary phase diagram lies lower in concentration and temperature than previously reported. Also the liquidus line on the WC side of the eutectic lies higher in temperature. Author (NSA)

N68-22754# General Electric Co., Schenectady, N. Y. Research and Development Center.

MAGNETIC BREAKDOWN OF CYCLOTRON RESONANCE ORBITS IN GALLIUM

T. W. Moore Feb. 1967 6 p refs
(Rept.-67-C-036)

A strong magnetic-field dependence of the relaxation time (line width and amplitude) of some cyclotron resonance lines in gallium is reported. This behavior is attributed to magnetic breakdown in which an electron tunnels through a band gap instead of undergoing normal Bragg reflection. It is shown that the effects of magnetic breakdown on cyclotron resonance can be simply interpreted as an additional scattering mechanism because of the requirement that $\omega_c T > 1$ for resonance to be observed. Extensive magnetic breakdown may be complicating the experimental determination of the Fermi surface. Author

N68-22829# Cornell Univ., Ithaca, N. Y. Materials Science Center.

AUDIO FREQUENCY ELECTROMAGNETIC PROPERTIES OF NORMAL AND SUPERCONDUCTING INDIUM

Edwin Freeman Johnson (Ph.D. Thesis) Jun. 1967 146 p refs
(Contract AT(30-1)-2150)
(NYO-2150-20) CFSTI: HC$3.00/MF$0.65

Helicon-like resonances have been observed in the intermediate state of high-purity polycrystalline indium, and an experimental investigation of their properties has been made. The dependence of the resonant amplitudes on the steady magnetic field and the temperature could be understood in terms of helicon theory providing the field-dependent relative permeability was included. Furthermore, the "Hall angle" derived by means of helicon expressions had a dependence on the steady magnetic field which was remarkably like that obtained by conventional techniques. In contrast, the "resistivity" and "Hall resistivity" calculated from the helicon expressions could not be understood by a reasonable model of the intermediate state. More experimentation is needed to clarify this point. As an extension of the studies of the intermediate state, the normal-state helicon was investigated in the limit of small steady magnetic fields ($\omega_c \tau \leq 1$). The resistivity and Hall coefficient derived from the helicon agreed (±15%) with those found by conventional measurements except at the lowest fields ($\omega_c \tau \leq 0.5$). The reasons for the discrepancies were not determined. Author (NSA)

N68-22830# Cornell Univ., Ithaca, N. Y. Materials Science Center.

THE DYNAMICS OF A NON-HARMONIC SUBSTITUTIONAL IMPURITY IN A DYNAMIC HOST LATTICE

Samuel Philip Bowen (Ph.D. Thesis) Sep. 1967 114 p refs
(Contract (AT(30-1)-3699)
(NYO-3699-23; Rept.-879) CFSTI: HC$3.00/MF$0.65

A study was made of small quantum systems coupled to a many-body quantum field. The purposes of the study are: (1) to develop a formalism for calculating properties of a small system in contact with a phonon bath, and (2) to apply this technique to a certain type of substitutional impurity in pure host crystals. NSA

N68-22831# Cornell Univ., Ithaca, N. Y. Materials Science Center.

OPERATION OF SUPERCONDUCTING INTERFERENCE DEVICES IN APPRECIABLE MAGNETIC FIELDS

M. R. Beasley and W. W. Webb 5 Sep. 1967 13 p refs
Presented at the Symp. on Phys. of Superconducting Devices, Charlottesville, Va., 28–29 Apr. 1967
(Contract AT(30-1)-3029)
(NYO-3029-23; Rept.-772; CONF-670443-1) CFSTI: HC $3.00/MF$0.65

The problems which arise in developing a practical measuring device for measurement in strong fields are discussed. A device used to study flux creep in superconductors is described that is capable of resolving field changes of less than 10^{-7} gauss, with a 1 sec. time constant, in an applied field of 2500 gauss thus obtaining a field resolution of better than 1 part in 10^{10}. This is the superconducting quantum interference device (SQUID), which uses the dc Josephson effect. NSA

N68-22878# Commissariat a l'Energie Atomique, Saclay (France).

EXPERIMENTAL DETERMINATION OF PHONON LIFETIME IN CRYSTALS [DETERMINATION EXPERIMENTALE DE LA DUREE DE VIE DES PHONONS DANS LES CRISTAUX]

Maurice Drifford Dec. 1967 15 p refs In FRENCH; ENGLISH summary
(CEA-BIB-100) CFSTI: HC$3.00/MF$0.65

The lifetime of phonons is determined by inelastic scattering of neutrons and photons, i.e., Raman scattering for optic phonons, Brillouin scattering for acoustic phonons. Some fundamental notions on dispersion curves and anharmonic effects in crystals are reported. The results obtained with some solids are discussed. Author

N68-22902# Commissariat a l'Energie Atomique, Saclay (France).

EXPERIMENTAL STUDY OF SUPERCONDUCTIVITY INDUCED BY PROXIMITY EFFECTS [ETUDE EXPERIMENTALE DE LA SUPRACONDUCTIVITE INDUITE PAR EFFETS DE PROXIMITE]

Alexis Martinet (Ph.D. Thesis—Paris Univ.) Dec. 1967 75 p refs In FRENCH
(CEA-R-3757) CFSTI: HC$3.00/MF$0.65

Studied were the proximity effects between a superconductor (InBi or PbBi alloys) and a normal metal (Zn or Sn, above their critical temperature) using essentially the tunneling techniques. In the normal metal, some specific properties of such an induced superconductivity are described: linear variation of the pair potential near the critical temperature of the binary layer, T_{CNS}; reduced energy scale at T_{CNS}; and evidence of a thermodynamic critical field, the breakdown field, which occurs above the critical temperature. In the superconductors, the crossing from a gapless to a quasi-gapless regime was studied. This establishes proof of a finite coherence length at T_{CNS}. Experimental details, particularly about the preparation and measurement of tunneling junctions, are given, and possible applications are suggested. K.W.

N68-22950# Sandia Corp., Albuquerque, N. Mex.

ELECTRIC FIELD DEPENDENT DIELECTRIC NONLINEARITIES OF ELECTROMORPHIC CERAMICS: DYNAMIC VS STATIC VALUES

E. P. EerNisse Jan. 1968 20 p refs
(Contract AT(29-1)-789)
(SC-RR-67-2928) CFSTI: HC$3.00/MF$0.65

The first derivative of the complex dielectric constant with respect to electric field was measured for three diffuse transition electromorphic ceramics under the dynamic conditions of parametric device operation. The measurements were made at 500 KHz and 25°C. These dynamic values are as much as 30% smaller than the corresponding slopes of 500-KHz small-signal dielectric constant vs static electric bias field curves at 25°C. The fact that the dynamic nonlinearity is smaller than the static value is attributed to the relaxator nature of the dielectric behavior of such ceramics. Of the antiferroelectric and two ferroelectric compositions investigated, the antiferroelectric composition was capable of more efficient high-frequency device operation because of its lower losses and larger dynamic nonlinearities at higher frequencies. Author (NSA)

N68-22976# Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics.
SOLID STATE PHYSICS; MAGNETIC PHENOMENA Progress Report, 1 Jan.–31 Dec. 1967
R. Bowers and R. H. Silsbee Jan. 1968 13 p
(Contract AT(30-1)-2150)
(NYO-2150-40) CFSTI: HC$3.00/MF$0.65

Research projects in solid state physics which focuses on studies of magnetic phenomena are reported. Included are studies of electron spin resonance spectra of FCN$^-$, ClCN$^-$, and HCN$^-$ radicals in potassium chloride; electron spin resonance spectra of lithium ions in potassium chloride; Cu–Mn electron spin resonance; magnetoresistance measurements on single crystal potassium and indium using helicon waves; helicon wave studies of superconductors; acoustic wave production in aluminum and silver by electromagnetic excitation; helicon studies of niobium superconductivity; thermal resistance and Righi–Luduc effects in indium; and lithium and tetraamine low temperature resistivity. S.C.W.

N68-23009# Missouri Univ., Rolla.
FERROELECTRIC PROPERTIES OF BISMUTH FERRATE AND RELATED MATERIALS Progress Report
Robert Gerson and William J. James Jan. 1968 48 p refs
(Contract AT(11-1)-1368)
(COO-1368-8) CFSTI: HC$3.00/MF$0.65

Neutron-diffraction measurements have been made on pure $BiFeO_3$ and some solid solutions containing $BiFeO_3$. The results for $BiFeO_3$ above its Neel temperature showed two peaks that could not be indexed on the basis of a simple rhombohedral cell and are very unlikely to be caused by impurities. Smaller peaks were found at the same angles in a rhombohedral perovskitic modification in the $Pb(Zr,Ti)O_3$ system, and it seems likely that this material and $BiFeO_3$ have similar superstructures. Neutron-diffraction patterns were also obtained for solid solutions in the $BiFeO_3$–$PbZrO_3$ system. It was found that superstructure peaks could be found in the compositional region that appears almost cubic to X-ray diffraction but is known to be ferroelectric. Apparently the displacements of oxygen atoms from cubic symmetry are responsible for the ferroelectricity. Some experiments were conducted using PbO, SnO_2, in place of $PbZrO_3$, as an additive to $BiFeO_3$–$PbTiO_3$. The effects were similar, but there was more difficulty with impurity phases and incomplete reaction when the tin oxide was used. Author (NSA)

N68-23011# Iowa State Univ. of Science and Technology, Ames.
EXPLICIT FORMULAE FOR THE MAGNETIC INDUCTION IN UNIFORMLY MAGNETIZED ELLIPSOIDS OF REVOLUTION
Candace A. Schau and Dennis R. Stone Dec. 1967 13 p refs
(Contract W-7405-ENG-82)
(IS-1734) CFSTI: HC$3.00/MF$0.65

The Stoner–Wohlfarth theory was extended to give implicit formulae for the magnitude and direction of the magnetic induction in a single-domain ferromagnetic ellipsoid of revolution. Explicit formulae for the magnetic induction were suggested by Gold; quantitative comparison shows that these approximate expressions compare quite well with the exact results obtained from the Stoner–Wohlfarth theory. Author (NSA)

N68-23033# Commissariat a l'Energie Atomique, Saclay (France).
MAGNETIC ANISOTROPY OF $Co_xFe_{3-x}O_4$ FERRITES [ANISOTROPIE MAGNETIQUE DES FERRITES $Co_xFe_{3-x}O_4$]
Pierre Vigier Dec. 1967 38 p refs In FRENCH; ENGLISH summary
(CEA-BIB-105) CFSTI: HC$3.00/MF$0.65

Much theoretical and experimental research has been carried out with the object of finding out the reasons for the unusual behavior, from the magnetic anisotropy point of view, of spinel ferrites containing cobalt. It is not possible to explain the high positive value of K_1 and the existence of an induced anisotropy by models based on precipitates or on the cobalt-vacancy directional order. The "one-ion" model conforms perfectly to the case of ferrites containing little cobalt; this model involves the energy of the spin-lattice coupling around the (111) axes. When the cobalt-ion concentration increases, it becomes necessary to complete this theory by taking into account the possible association of two or three close-neighbor cobalt ions. Author

N68-23034# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.
TEMPERATURE DEPENDENCE OF THE MAGNETIZATION OF AN AMORPHOUS FERROMAGNET Research and Development Report No. 53
C. C. Tsuei, G. Longworth, and S. C. H. Lin Jan. 1968 17 p refs
(Contract AT(04-3)-221)
(CALT-221-38) CFSTI: HC$3.00/MF$0.65

The results of magnetization and hyperfine field measurements definitely indicate that the amorphous alloy $Fe_{80}P_{12.5}C_{7.5}$ is ferromagnetic. The magnetization of such an alloy varies with temperature in the same way as that of a crystalline ferromagnet, i.e., essentially according to a Brillouin function with a relatively well-defined Curie temperature. Although the magnetic moment is only slightly smaller than that of pure iron, the Curie temperature is greatly reduced possibly because of the lack of strict periodicity in the atomic arrangement. Author (NSA)

N68-23044# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
INVESTIGATIONS OF MAGNONS IN HEXAGONAL COBALT
S. Krasnicki, A. Wanic, Z. Dimitrijevic, and J. Todorovic Oct. 1967 5 p refs Submitted for publication
(INP-568-PS)

Inelastic magnon scattering of neutrons ($\lambda = 1.124$ Å) on a single crystal of hexagonal cobalt was investigated by the neutron diffraction technique. The dispersion relation for the acoustic magnon branch, up to the energy 0.035 eV, in the [001] direction of propagation was obtained. Author (NSA)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N68-21865*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SUMMARY OF A STUDY OF THE LOW-PRESSURE COMBUSTION OF SOLID PROPELLANTS
L. D. Strand 15 Apr. 1968 34 p refs
(Contract NAS7-100)
(NASA-CR-94238; JPL-TR-32-1242) CFSTI: HC $3.00/MF $0.65 CSCL 21I

The phenomena of solid propellant low-pressure instability and extinguishment were investigated. The investigation included a motor firing test program, a series of transparent motor tests, rather extensive reduction and analyses of the test data, and attempts to develop theoretical models that would accurately describe the experimental phenomena. Under the motor firing program, information on the influence of the following propellant variables on low-pressure extinction was obtained: (1) propellant configuration, (2) aluminum/oxidizer concentration ratio, (3) aluminum particle size, (4) oxidizer particle size, and (5) binder type. The series of transparent motor tests which were conducted were designed to gain insight into the actual mechanisms causing low-pressure extinction. Further reduction and analysis of the motor firing test data yielded information on the point of onset of instability, the frequency dependence of the instability on the rocket chamber pressure and motor free volume/throat area ratio, and the significance of the pressure oscillation rate-of-depressurization on the extinction process. Comparison of the low-pressure combustion data with existing theoretical models resulted in qualitative agreement only. Low-pressure motor free volume/throat area ratio extinction is concluded to be due to self-induced pressure perturbations and is believed to be a manifestation of the same phenomenon controlling rapid depressurization combustion extinction. Author

N68-21893*# Atlantic Research Corp., Alexandria, Va.
STUDY OF PROPELLANT VALVE LEAKAGE IN A VACUUM Final Summary Report
Ralph D. Gift, John A. Simmons, Jack M. Spurlock, Joseph P. Copeland, and Jaydee M. Miller Washington NASA Apr. 1968 12 p ref
(Contract NAS9-4494)
(NASA-CR-1047) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Condensed summary report is presented of an investigation of the adverse effects of propellant leakage through propellant valves and into rocket injector manifolds and combustion chambers exposed to a vacuum environment. In space, during a nonfiring condition, these various regions of the engine are exposed to a vacuum environment. Consequently, should any propellant leak past the control valve, it can freeze and accumulate in the injector flow passages and combustion chamber. Investigation was conducted to study the likelihood that such accumulation may cause blockage of the propellant flow system or result in a catastrophic hard start. The investigation consisted of concurrent theoretical and experimental studies, with emphasis of consideration being given to the factors that could affect the performance of the Apollo Service Propulsion System and the Gemini Orbit Attitude Maneuvering System engines. Author

N68-21975*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
A STUDY OF LIQUID PROPELLANT BEHAVIOR DURING PERIODS OF VARYING ACCELERATIONS Summary Report
23 May 1967 11 p
(Contract NAS9-5174)
(NASA-CR-92082; LMSC-A874729) CFSTI: HC $3.00/MF $0.65 CSCL 21I

The static and dynamic behavior of liquid propellants in rocket tanks continues to be a subject of much concern to the propulsion system designer. Because of the increased sophistication of space vehicles, however, emphasis has shifted to the study of liquid behavior in tanks under conditions where the net body force per unit mass is very low compared to those encountered in the normal earth-bound state. Such circumstances have been called low-g conditions. The purposes of the present study are to determine analytically the important aspects of liquid behavior affecting the performance of liquid rocket propelled spacecraft with special emphasis on liquid behavior in low-g and transient situations, and to obtain experimental verification and, where possible, extension of the results of analysis. The work carried out in this study has been primarily influenced by the problems to be met in the use of so-called space storable propellants. The additional complications encountered in the use of cryogenic propellants were not considered. Author

N68-22463*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ENGINEERS HANDBOOK: LOW-G PROPELLANT BEHAVIOR
H. M. Satterlee and M. P. Hollister 15 May 1967 169 p refs
(Contract NAS9-5174)
(NASA-CR-92083; LMSC-A874831) CFSTI: HC $3.00/MF $0.65 CSCL 21I

A handbook designed to assist engineers working on propulsion and vehicle dynamics of rocket propelled space vehicles to predict the behavior of liquids in rocket propellant tanks; is reported. Emphasized is the low-g liquid behavior. Primary objectives of the handbook are to explain how liquids behave in rocket propellant tanks and to provide tools for the solution of the more important types of liquid behavior problems. Contents include discussions of liquid propellant shape, sloshing behavior, stability, reorientation behavior, draining and vortexing, and heat transfer problems with emphasis on low-g aspects of these problems. Also discussed are design procedures for passive liquid retention systems for storable propellants, and experimental techniques useful in the study of low-g liquid propellant behavior. S.C.W.

N68-22879*# Bendix Corp., Davenport, Iowa. Instruments and Life Support Div.
POSITIVE GAGING SYSTEM, FEASIBILITY STUDY Final Report, 15 May–15 Nov. 1967
17 Apr. 1968 140 p refs
(Contract NAS9-6751)
(NASA-CR-92091; Publ-3914.1-68-2) CFSTI: HC $3.00/MF $0.65 CSCL 21I

Three RF techniques of mass gaging were studied, both theoretically and experimentally, to determine their capability to gage the propellants, N_2O_4, Aerozine 50 and MMH, in Apollo or LEM spacecraft tanks. The theoretical work predicts the response of each technique relative to the propellants and tanks. The experimental evaluation of this theory was performed using a scale model SPS tank, and a N_2O_4 simulant. A study was also made of the dielectric properties of the propellants over the expected range of operating conditions. Finally, a preliminary specification was made of the system's expected characteristics and components needed for the flight implementation of each of the techniques. Author

N68-23024*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
A STUDY OF LIQUID PROPELLANT BEHAVIOR DURING PERIODS OF VARYING ACCELERATIONS Final Report
M. P. Hollister, H. M. Satterlee, and H. Cohan 30 Jun. 1967 509 p refs
(Contract NAS9-5174)
(NASA-CR-92084; LMSC-A874728) CFSTI: HC $3.00/MF $0.65 CSCL 21I

Liquid behavior in rocket propellant tanks was studied under space flight conditions to permit prediction of behavior for any acceleration level. Reorientation of liquids in rocket tanks subjected to settling impulses and large amplitude lateral liquid motions was studied, as was small amplitude lateral sloshing and axial motion of liquids from post-engine shutdown relaxation of tank shells. Predicting behavior of tank baffles was studied, and results on small amplitude lateral sloshing were used to estimate damping afforded by baffles. Applications are considered for predicting Apollo mission liquid behavior in the service propulsion system, lunar module during both lunar descent and ascent, and fluid stability of the service module propellant retention system, and a liquid behavior experiment aboard a Gemini spacecraft is reported. M.W.R.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N68-21901*# Giannini Scientific Corp., Santa Ana, Calif.
EXPLORATORY ELECTROMAGNETIC THRUSTER RESEARCH Annual Report
A. C. Ducati, R. G. Jahn, E. Muehlberger, and R. P. Treat Feb. 1968 75 p refs
(Contract NASw-1513)
(NASA-CR-62047; TR-117-1513) CFSTI: HC $3.00/MF $0.65 CSCL 21C

A cylindrical fiberglass tank 25 feet long and 10 feet in diameter has been constructed and tested. Pressures between 10^{-5} and 10^{-4} torr are obtained with a 0.1 to 1 mg/sec H_2 mass flow. The structural and vacuum properties of the tank are entirely satisfactory. The thrust stand is aerodynamically and electromagnetically isolated from the tank environment. Provision has been made for the interchange of thruster and thruster components while maintaining a high vacuum. Initial tests in the high vacuum insulated tank are discussed. An analysis of the arc has been conducted by means of an analytical model which assumes only electromagnetic forces. The analysis yields the plasma motion and current density variation following the motion of a plasma element through the discharge. A reexamination of the use of an external magnetic field to improve performance is given. Various aspects of the external field interactions are presented. Author

N68-21907# European Space Vehicle Launcher Development Organization, Paris (France). Studies and Exptl. Work Directorate.
SOME ASPECTS OF ADVANCED PROPULSION SYSTEMS APPLICATIONS [QUELQUES ASPECTS DE L'UTILISATION DES SYSTEMES DE PROPULSION AVANCEE]
J. P. Contzen Sep. 1967 24 p In FRENCH Presented at the 18th Intern. Congr. of Astronautics, Belgrade, Sep. 1967
(ELDO-TM-105) CFSTI: HC$3.00/MF$0.65

Advanced electric and nuclear propulsion systems are examined in view of their application to future European space vehicle launchers. Performance analysis points out favorable characteristics, against chemical propulsion, when used with powerful launchers. Existing technology provides a good basis for further developments. ESRO

N68-21944*# Hughes Research Labs., Malibu, Calif.
ION ENGINE THRUST VECTOR STUDY
G. R. Brewer, K. Amboss, G. Nudd, H. King, R. Seliger et al Apr. 1968 69 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952129)
(NASA-CR-94250; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 21C

The purpose of this investigation is to establish the probability that thrust vector misalignment will occur in an ion thruster array. To accomplish this it is necessary to establish first the probability that any combination of a number of possible mechanical perturbations in the system may occur, second to investigate the effect of such perturbations on the ion trajectories, and finally to interpret this information in terms of thrust variations for a single thruster and the array of thrusters. This report discusses progress made during the first three months of a nominal two year program to conduct the above investigation by a combined analytical-experimental technique. Author

N68-22037*# Aztec School of Languages, Inc., Acton, Mass.
THEORY OF A SUPERSONIC GAS EJECTOR WITH A CYLINDRICAL MIXING CHAMBER [TEORIYA SVERKHZVUKOVOGO GAZOVOGO EZHEKTORA S TSILINDRICHESKOY KAMEROY SMESHCHENIYA]
Yu. N. Vasil'yev Washington NASA Apr. 1968 69 p refs Transl. into ENGLISH from the Publ. "Lopatochniye Mashini i Struynyye Apparati, Sbornik Statey" Moscow, Mashinostr. Press, 1967 p 171–235
(Contract NASw-1692)
(NASA-TT-F-11554) CFSTI: HC$3.00/MF$0.65 CSCL 21H

Theoretical analysis is presented of a gas ejector having a cylindrical mixing chamber for a low pressure and high pressure gas. The high pressure gas is introduced into the chamber through an expanding supersonic nozzle. The features of gas flow are analyzed in detail at the inlet section of the mixing chamber and at the nozzles. The characteristics of the ejector are determined for all possible pressure ratios and heat contents during the mixing of gases having different physical properties. The relationship between gas parameters at the inlet and outlet cross sections of the ejector are studied and all possible regimes of ejector operation are described and classified. The regimes of subcritical and critical operation are examined together with the condition of nozzle and mixing-chamber occlusion. A method of designing an optimal ejector is described. Author

N68-22096*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPTIMAL FINITE-THRUST TRANSFER BETWEEN PLANET APPROACH AND DEPARTURE ASYMPTOTES WITH SPECIFIED INTERMEDIATE ORBIT
Edward A. Willis, Jr. Washington Apr. 1968 59 p refs
(NASA-TN-D-4534) CFSTI: HC$3.00/MF$0.65 CSCL 22C

Optimal control and finite thrust aspects of the approach maneuver–planetocentric orbit–departure maneuver sequence at the destination planet of a round trip are studied. Solutions are developed for single maneuvers, and conditions for joining these into an optimal total trajectory are derived. Numerical results are presented for an elliptic parking orbit and typical asymptotic velocities and directions. It is shown that gravity losses and steering losses are not directly additive, low vehicle thrust to weight ratios are desirable, and trajectories with single-burn escape and capture maneuvers are usually advantageous. Author

N68-22266*# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
DEVELOPMENT REQUIREMENTS FOR A HIGH-ENERGY HYBRID PROPULSION SYSTEM Final Report
Mar. 1968 152 p refs
(Contract NAS1-7289)
(NASA-CR-66597; DAC-58080) CSCL 21H

The development requirements, costs, and schedule for a high-energy upper-stage hybrid propulsion system are discussed. High energy is achieved through the use of a lithium fuel formulation (solid) and fluorinated oxidizer (liquid). The propulsion system contains 3,200 lb of propellant and may be used as a terminal stage for Atlas/Centaur or DSV-3M Delta launch vehicle. A program to develop a fluorinated hybrid propulsion system could be initiated with little risk. An extensive investigation revealed that the technology required to develop most of the components has either been demonstrated or is in progress. Further, it was found that there were no areas of critical technology. The cost to develop a hybrid propulsion system to a status where it could be integrated into a flight-test stage is about $17 million. This cost does not include the development of the stage astrionics. A total recurring cost was estimated for the first unit (less astrionics and fee). Author

N68-22272*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL EVALUATION OF 7.82-INCH (19.8-CM) DIAMETER THROAT INSERTS IN A STORABLE-PROPELLANT ROCKET ENGINE

Jerry M. Winter and Donald A. Peterson Washington Apr. 1968 47 p refs

(NASA-TM-X-1463) CFSTI: HC$3.00/MF$0.65 CSCL 21H

A total of 14 nozzle throat inserts of 7.82-inch diameter were evaluated for use with reinforced plastic thrust chambers. The propellants used were nitrogen tetroxide and a blend of 50 percent hydrazine with 50 percent unsymmetrical dimethyl-hydrazine. Primary failure mechanisms were determined for specific materials and design concepts. Detailed failure mechanisms were explored as a means of recommending material and design modifications to improve reliability and performance. Silicon carbide provided erosion protection for 100 seconds of continuous firing. However, both one-piece and segmented silicon carbide inserts failed structurally. Tungsten infiltrated with copper or silver had relatively high resistance to oxidation for approximately 250 seconds of run time. The copper-infiltrated insert was structurally sound after a firing duration of 340 seconds. Careful attention to substrate design and coating techniques appreciably increased the erosion resistance of coated inserts. A preferentially oriented pyrolytic graphite design was partly successful, but, to realize the full potential of this design, additional development work would be required. Only limited correlation between small- and large-size testing was obtained. However, the time to failure for large-scale monolithic inserts was extended over small-scale inserts. Author

N68-22300*# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.

HYBRID DEVELOPMENT PLANNING MANUAL

M. B. Adams, P. H. Bialla, and R. H. Michaelis Mar. 1968 124 p (Contract NAS1-7289)

(NASA-CR-66598; DAC-58081) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Parametric data presented for estimating development cost, first unit cost, and development schedule for hybrid propulsion systems are based on the evaluation of program costs and schedules for several types of subsystems over a large range of mission-imposed criteria. These criteria, their ranges, and the subsystems were selected to encompass the potential hybrid upper stage mission requirements for the next decade. Cost estimates are of a budgetary planning nature and are based on a development program initiated after the completion of both mission analysis and propulsion system definition and concluded after the propulsion system can be integrated into the flight test program. Characteristics of a baseline propulsion system were developed and expanded to apply to a variety of hybrid propulsion concepts and mission criteria. Instructions for the use of this manual are included; and a definition is given of the subsystem options available and the data required to estimate both development and unit costs of the subsystems. M.W.R.

N68-22326*# Aerojet-General Corp., Sacramento, Calif. Liquid Rocket Operations.

INDUCER DYNAMICS FULL-FLOW, FULL-ADMISSION HYDRAULIC TURBINE DRIVE Interim Report for Tasks 1, 2, and 3

J. Farquhar, B. K. Lindley, E. B. McKinney, G. K. Olson, and P. S. Buckmann 1968 224 p refs

(Contract NAS3-7977)

(NASA-CR-72378; AGC-7977-T1) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Hydrodynamical and mechanical design layout for a two-speed inducer system is described, and computer models for the formulation and demonstration of its pumping system as well as for both steady state and transient performance of the test facility are detailed. The low-speed inducer is driven by an hydraulic turbine whose power comes from a rotor connected to the high-speed drive; the high-speed rotor blading is mounted between the low speed inducer and the turbine blading. The system was designed to operate in liquid hydrogen at 4900 gpm with net positive suction head at 25 ft and cavitating head rise of 5,453 ft; the high-speed rotor was designed to operate at 44,500 rpm and the low-speed at 18,800 rpm. Parametric studies are included for both closed and open loop systems; and the demonstration unit was found to bootstrap satisfactorily for both 3 and 9 sec NERVA pump test facility transients; the demonstration unit can also be made to bootstrap with an advanced hydrogen main stage pump on a tank-head start. M.W.R.

N68-22370*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AN EXPERIMENTAL INVESTIGATION OF A HIGH-VOLTAGE ELECTRON-BOMBARDMENT ION THRUSTER

David C. Byers Washington 1968 44 p refs Presented at the Spring Natl. Meeting of the Electrochem. Soc., Boston, 5–9 May, 1968

(NASA-TM-X-52429) CFSTI: HC$3.00/MF$0.65 CSCL 21C

The performance of a mercury electron-bombardment thruster at large values of net accelerating potential is described. A 20-centimeter-diameter thruster was tested at values of ion beam current and net accelerating potential up to 0.165 ampere and 70 kilovolts, respectively. A maximum beam power of about 10 kilowatts was obtained. The maximum supportable electric field strength between accelerator grids was approximately constant at 2×10^6 volts per meter for spacings between 0.5 and 3.0 centimeters. Ion focusing characteristics, at ion beam current densities of about 10 amperes per square meter, indicated that the ratio of center-to-center grid spacing to grid thickness should be between about 2.5 and 4 to avoid direct ion impingement. Accelerator grid lifetimes up to two years were calculated for net accelerating potentials between 20 and 70 kilovolts. A power efficiency of 0.8 was obtained at a net accelerating potential of 18 kilovolts and rose to 0.88 at a net accelerating potential of 36 kilovolts. Overall thruster efficiencies of about 0.80 and 0.82 were obtained at net accelerating potentials of 28 and 36 kilovolts, respectively. Author

N68-22461# Royal Aircraft Establishment, Farnborough (England).

CAVITATION DAMAGE IN FUEL-INJECTION APPARATUS OF DIESEL ENGINES [KAVITATIONSVERSCHLEISS IN KRAFTSTOFF-EINSPRITZANLAGEN FUR DIESELMOTOREN]

W. Schaffitz Oct. 1967 17 p refs Transl. into ENGLISH from Internationaler Automobiltech. Kong., Muenchen, West Germany, 12–16 Jun. 1966

(RAE-LIB-TRANS-1252) CFSTI: HC$3.00/MF$0.65

The requirements which have been established in connection with the control and mixture formation of injection systems frequently involve the occurrence of fuel cavitation; this has previously been considered, for the most part, only in regard to its effect on the hydraulic function of the system. Recently, however, in injection equipment, erosion phenomena have been observed which could be caused as a result of the cavitation process. Since it is difficult, without detriment to the mixture formation or without increasing the constructional complications, to avoid the cavitation process as such in all cases, the question arises, in this particular case, as to the existence and order of importance of various erosion factors which, in addition to the probably dominating effect of cavity implosion, are of significance. Author

N68-22530*# Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.

BIPROPELLANT AND QUADREDUNDANT VALVES, VOLUME 1 Final Report

17 Jul. 1967 66 p

(Contract NAS8-15486)

(NASA-CR-61732; RMD-6203-Q2, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Qualification test results for bipropellant and quadredundant propellant valves are reported. The bipropellant valve employs a torque motor to simultaneously open and close the fuel and oxidizer ports by using a movable flapper, and the quadredundant valve uses a manifold to operate four individual torque motors to provide redundant series-parallel flow path within the oxidizer and the fuel body. The bipropellant valve qualified fully for space use in the C-1 engine whereas the quadredundant fuel valve failed the dielectric strength test in a vacuum. G.G.

N68-22586*# Avco Corp., Lowell, Mass. Space Systems Div.

DESIGN, DEVELOPMENT, FABRICATION, TEST, AND DELIVERY OF ELECTROTHERMAL ENGINE SYSTEMS

T. K. Pugmire Nov. 1967 122 p refs

(Contract NAS3-7934)

(NASA-CR-72362; AVSSD-0062-68-RR) CFSTI: HC $3.00/MF $0.65 CSCL 21H

A program for the design, development, fabrication, test, and delivery of an electrothermal three-axis spacecraft attitude control and four-direction station-keeping system is described. Qualification and performance tests have demonstrated the specified control and operation of a fully active resistojet propulsion system following launch and space environmental testing. The system is composed of the following subsystems: ammonia propellant storage; thrust pressure regulation; electrothermal resistojet thrustors; control logic; and power and signal conditioning. The system was designed and developed for a hypothetical spacecraft in the 300 to 1200 pound class. A principal system feature is the adaptability of the several subsystems with minimum effort to meet the auxiliary propulsion requirements of an actual spacecraft. Author

N68-22683*# Purdue Univ., Lafayette, Ind. Jet Propulsion Center.

INVESTIGATIONS IN CHEMICAL ROCKET PROPULSION Final Report, 1 Jul. 1964–31 Dec. 1967

C. M. Ehresman 31 Dec. 1967 23 p

(Grant NsG-592)

(NASA-CR-94386) CFSTI: HC $3.00/MF $0.65 CSCL 21H

A summary of data is presented on research being conducted in the areas of jet propulsion, liquid and solid rocket propellants, and combustion processes. The heat and mass transfer phenomena characteristic of the process of liquid-film cooling is discussed, and a flux method for determining optimum thrust nozzle contours for chemically reacting gas flows and gas particle flows is presented. Liquid rocket research activities centered on the influence of high combustion pressure upon performance, heat flux and combustion stability. An experimental investigation of the gaseous phase reaction zone in a composite solid is described along with an investigation of the chemical processes leading to the ignition of a solid propellant. Results are also presented on the surface temperature measurement of burning ammonium perchlorate. Details are also given on a linear pyrolysis method, which was developed to represent the intense surface heating environment of a burning propellant. B.S.D.

N68-22725*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ANALYSIS OF FAN-TURBINE EFFICIENCY CHARACTERISTICS IN TERMS OF SIZE AND STAGE NUMBER

Warner L. Stewart and Arthur J. Glassman Washington May 1968 19 p refs

(NASA-TM-X-1581) CFSTI: HC $3.00/MF $0.65 CSCL 21E

This report presents a study of fan-drive turbine geometry and efficiency interrelations both in generalized form in terms of specific speed and specific diameter and for a selected set of representative turbofan engine conditions. Results are presented in terms of turbine efficiency and diameter variations as a function of number of stages for a range of fan speeds. Also shown are the variations in engine specific thrust and specific fuel consumption as functions of fan-turbine efficiency for the selected engine conditions. Author

N68-22818* Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.

C-1 ENGINE. PROPELLANT VALVE QUALIFICATION, VOLUME 2, BOOK 3 Final Report

J. McGall 17 Jul. 1967 332 p

(Contract NAS8-15486)

(NASA-CR-61733; RMD-6203-Q2, V. 2, Bk. 3) CFSTI: $3.00 CSCL 21H

Both nonoperating and operating vibration tests were completed on specimens of the C-1 Rocket Engine during propellant valve qualification testing. Oscillograph recordings of the accelerometer outputs were obtained during sinusoidal vibration testing, and the X–Y plots of the accelerometer outputs obtained during random vibration testing are included. These vibration tests and shock tests did not produce any visible evidence of damage. Detailed acceptance test data are included. M.W.R.

N68-23028* Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.

C-1 ENGINE PROGRAM. QUALIFICATIONS TEST REPORT FOR BIPROPELLANT AND QUADREDUNDANT VALVES, VOLUME 2: APPENDICES Final Report

17 Jul. 1967 334 p

(Contract NAS8-15486)

(NASA-CR-61734; RMD-6202-Q2, V. 2) CFSTI: $3.00 CSCL 21H

Requirements are detailed for pulse modulated and mechanically linked bipropellant dual torque motor operated valve that is used with the C-1 rocket engine, and qualification test plans for the valve and the rocket engine are presented. Radiated radio frequency susceptibility and propellant compatibility are specified, along with electrical and structural integrity tests. Results are included for acceleration, shock, vibration, and other testing; and numerous random vibration X–Y plots are presented. Detailed test program, specimens, conditions, and procedures are included in each case. M.W.R.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N68-22399# National Environmental Satellite Center, Washington, D. C.

ANGULAR DISTRIBUTION OF SOLAR RADIATION REFLECTED FROM CLOUDS AS DETERMINED FROM TIROS 4 RADIOMETER MEASUREMENTS

I. Ruff, R. Koffler, S. Fritz, J. S. Winston, and P. K. Rao Mar. 1967 67 p refs
(NESC-38)

The pattern of reflection of solar radiation from clouds as a function of angle is obtained by statistical analysis of observations from the TIROS IV visible radiation channel (0.55 μ to 0.75 μ). Readings from the water vapor window channel (8 μ to 12 μ) were used to select cases in which clouds fill the field of view of the sensor. The results show a generally non-isotropic reflection pattern, which varies with solar zenith angle. The anisotropy is greatest for large values of solar zenith angle, the main feature in these cases being the high intensity values of the radiation reflected at azimuths close to 180° from the sun, and at large zenith angles. Author

N68-22425*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

COSMIC RAY DEUTERIUM AND HELIUM-3 OF SECONDARY ORIGIN AND THE RESIDUAL MODULATION OF COSMIC RAYS

Reuven Ramaty and Richard E. Lingenfelter Apr. 1968 55 p refs
(NASA-TM-X-63178; X-611-68-144) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Assuming that cosmic ray deuterons and helium-3 nuclei are of secondary origin, it is shown that a unique determination of both the cosmic ray path length and the residual interplanetary field modulation of solar minimum may be made from a comparison of the calculated and measured intensities of these two nuclei. The production of deuterium and helium-3 by cosmic ray interactions in the galaxy is calculated, considering energy-dependent cross-sections, interaction kinematics and demodulated cosmic ray spectra. The resulting flux at the earth is obtained by taking into account leakage from the galaxy, ionization losses, nuclear breakup and modulation. From a comparison of these calculations with the measured deuterium and helium-3 intensities at the earth, it is concluded that all the data can be understood in terms of an energy-independent cosmic ray path length and a residual interplanetary field modulation at solar minimum. Author

N68-22849*# Boeing Co., Seattle, Wash.

STUDY OF RADIATION HAZARDS TO MAN ON EXTENDED MISSIONS

S. B. Curtis and M. C. Wilkinson Washington NASA May 1968 89 p refs
(Contract NASw-1362)
(NASA-CR-1037) CFSTI: HC $3.00/MF $0.65 CSCL 06R

This study attempts to identify the particle types and energies which are important in the evaluation of the radiation hazard on long manned missions outside the magnetosphere. Important areas where information is presently lacking are identified. Spectra of the various components of the galactic cosmic radiation have been compiled from experimental data gathered during the period of minimum solar activity. These spectra, as well as typical solar particle spectra, have been used to determine depth-dose curves and differential particle and dose spectra behind typical shielding thicknesses. From this analysis, the important energies for various thicknesses and various spectra have been determined. In general, low energy particles (below 100 MeV) appear to be the most important at the dose point in solar particle events. From the biological standpoint, very low energy particles are important only for very steep spectra. The high energy heavy component of the galactic cosmic rays is of considerable importance for thin shielding and it appears that low energy heavy particles may continue to be important at thicker shielding, although secondary production data are not available for a thorough analysis. Author

N68-22925*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

EQUILIBRIUM SPECTRA OF SECONDARY COSMIC-RAY POSITRONS IN THE GALAXY AND THE SPECTRUM OF COSMIC-GAMMA-RAYS RESULTING FROM THEIR ANNIHILATION

F. W. Stecker Apr. 1968 45 p refs
(NASA-TM-X-63187; X640-68-135) CFSTI: HC $3.00/MF $0.65 CSCL 20H

A general formula is derived for calculating the gamma-ray spectrum resulting from the annihilation of cosmic-ray positrons. This formula is used to calculate annihilation-gamma-ray spectra from various equilibrium spectra of secondary galactic positrons. These spectra are then compared with the gamma-ray spectra produced by other astrophysical processes. Particular attention is paid to the form of the gamma-ray spectrum resulting from the annihilation of positrons having kinetic energies below 5 keV. It is found that for mean leakage times out of the galaxy of less than 400 million years, most of the positrons annihilating near rest come from the beta decay of unstable nuclei produced in cosmic-ray $p–C^{12}$, $p–N^{14}$, and $p–O^{16}$ interactions, rather than from pi-meson decay. It is further found that the large majority of these positrons will annihilate from an S state of positronium and that 3/4 of these will produce a three-photon annihilation continuum rather than the two-photon line spectrum at 0.51 MeV. Results of numerical calculations of the gamma-ray fluxes from these processes are given. Author

N68-22957 Lockheed Missiles and Space Co., Palo Alto, Calif.

X-RADIATION OF THE MOON AND COSMIC X-RAY BACKGROUND FROM "LUNA-2" LUNAR SATELLITE DATA

S. L. Mandel'shtam, I. P. Tindo, G. S. Cheremukhin, L. S. Sorokin, and A. B. Dmitriev 6 Jul. 1967 9 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 1, 1968 p 119–127

Results are presented of measurements of the soft X-radiation of the moon, which probably originated during fluorescence of the lunar surface under the effect of solar X-radiation. The flux of lunar X-radiation in the 8 to 14 Å range was ≈ 10 to 150 photons/cm^{2}sec-ster at different time periods. The cosmic X-ray background was ≈ 7.5 photons/cm^2-sec-ster in the 8 to 12 Å range of the spectrum. Corpuscular flows recorded near the moon were apparently electrons of solar origin with E=50 keV energy, reaching ≈ 1.10^3 particles/cm^2-ster. The flux intensity correlates well with the geomagnetic disturbability index A_p Investigations of the X-radiation of the moon started with the "Luna-10" satellite, were continued with the aid of the "Luna-12" to further search for the soft X-radiation of surface layers of the moon, which have X-ray-fluorescent nature and originate under the effect of solar X-radiation. Author

N68-23026*# Minnesota Univ., Minneapolis. School of Physics and Astronomy.

AN ATLAS OF 10–50 KEV SOLAR FLARE X-RAYS OBSERVED BY THE OGO SATELLITES, 5 SEPTEMBER 1964 TO 31 DECEMBER 1966

R. L. Arnoldy, S. R. Kane, and J. R. Winckler Jan. 1968 82 p refs
(Contract NAS5-2071)
(NASA-CR-94429; CR-108) CFSTI: HC $3.00/MF 0.65 CSCL 03B

Ionization rate profiles are presented for about 70 solar events that represent almost all of the cases detected by the ion chambers during the observing times of OGO-I and OGO-III through the end of 1966. Some data on the instrumentation are included for these preliminary studies relating to X-ray phenomena in radio emission. Besides listing of frequency and the observing station, the presence of the radio emission is indicated on the plots by a horizontal line with a vertical arrow marking the reported time of maximum. Although radio information is quite complete, the absence of an indicated radio burst in some cases is due to the unavailability of information and does not necessarily mean a radio burst did not occur. M.W.R.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N68-21845*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.

COSMOLOGY OF OUR UNIVERSE

Hong-yee Chiu [1967] 49 p refs

(NASA-CR-94166) CFSTI: HC$3.00/MF$0.65 CSCL 03C

The present status of cosmology is reviewed. The applicability of laboratory tested physical laws to the study of our Universe is stressed by giving examples of extremely accurate laws of physics. The astronomical information regarding the large scale structure of our Universe is discussed. From this information the Einstein–Friedmann cosmology is developed. The physical processes that take place during the evolution of our Universe are described. Consideration is given on how cosmological theories can be tested by observing the remnants of creation of our Universe and by observing the large scale structure of our Universe. It appears that our Universe can be described by the open model of the big bang theory. Author

N68-21864*# Heliodyne Corp., Van Nuys, Calif.

NON-LINEAR ORBIT DETERMINATION METHODS

Ali Hasan Nayfeh Washington NASA May 1968 43 p refs

(Contract NAS1-6690)

(NASA-CR-1040) CFSTI: HC$3.00/MF$0.65 CSCL 22C

A non-linear correction method for orbit determination using range, azimuth, and elevation data is presented and justified mathematically and numerically. In contrast with conventional methods, such as the least-squares, the maximum likelihood, and the Kalman, this method holds in the non-linear, as well as in the linear regions. Moreover, this method does not require transition and normal matrices and, hence, avoids the problems associated with calculating and inverting them. The convergence and accuracy of the method have been demonstrated by calculations made on simulated orbits with varying levels of noise. The calculations demonstrate that the proposed method is non-linear and can be used as an editing procedure because it converges despite the combined effect of very bad reference orbits, extremely high levels of noise, wild data points, and critical orbits. The calculations show also that the errors of the resultant epoch state vectors are indeed very small. Author

N68-21868*# Avco Corp., Lowell, Mass. Space Systems Div.

NINETEEN SEVENTY TWO VENUS FLYBY/ENTRY PROBE MISSION STUDY, BOOK 2 Final Technical Report

Apr. 1968 504 p refs Prepared for JPL

(Contracts NAS7-100; JPL-951964)

(NASA-CR-94234; AVSSD-080-68-R, Bk. 2) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The results of a study of a 1972 Venus Flyby/Entry Probe Mission are presented, in which consideration is given to the Entry Probe Aeroshell Technology Study Addendum Flyby Probe Synthesis and program schedule, cost, effectiveness and risk summary. In the Study Addendum, emphasis was centered on the thermodynamics area, in which the objectives were: (1) prediction of the aerothermal environment, (2) prediction of material performance, (3) failure mode identifications, (4) defining preferred materials candidates, and (5) development of testing simulation. The Flyby Probe Synthesis is discussed in relation to system requirements and constraints, system and configuration design, and design of the major subsystems. A program schedule is given along with costing ground rules, program costs, and cost effectiveness for alternate approaches. B.S.D.

N68-21896*# California Univ., Berkeley. Space Sciences Lab.

A NEW METHOD OF MAGNETOGRAPH OBSERVATION OF THE PHOTOSPHERIC BRIGHTNESS, VELOCITY, AND MAGNETIC FIELDS

Robert Howard, Andrew S. Tanenbaum, and John M. Wilcox 30 Jan. 1967 29 p refs *Its* Ser. No. 9, Issue No. 7

(Grants NsG-243; NGR-05-003-230; NSF GA-1319; Contract Nonr-3656(26))

(NASA-CR-94225; AD-666112) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Several improvements have been made to the Mt. Wilson Observatory solar magnetograph, including changes to the guider, the Doppler compensator, and the data handling system. The improved magnetograph has been used for a new type of solar observation consisting of several hundred scans back and forth along a straight line of length 3/4 R sub o perpendicular to central meridian. The data reduction, which is done entirely with a computer, eliminates those effects which have their origin in the earth-sun geometry. The spatial and temporal properties of the 5-minute oscillations are discussed. Author (TAB)

N68-21920*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

COMBINED SOLUTION FOR LOW DEGREE LONGITUDE HARMONICS OF GRAVITY FROM 12 TO 24 HOUR SATELLITES

Carl A. Wagner Apr. 1968 15 p refs

(NASA-TM-X-63169; X-643-68-131) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Over 600 near stationary orbits of five high altitude communications satellites have been examined for the strong effects on them of low degree earth gravity harmonics. The accelerated drift of these 12 and 24 hour orbits, due to the earth's anomalous potential, has been measured at 50 longitude locations. From these accelerations, 5 low degree earth gravity harmonics which resonate with these orbits have been calculated (10 gravity coefficients). The best determined harmonic is felt to be H_{22}, which dominates the accelerated drift of the three 24 hour satellites (SYNCOMS 2, 3, and Early Bird) and the two 12 hour satellites (Molniya 1 and Cosmos 41). The constants found for this harmonic are (Normalized): $10^6C_{22} = 2.40 \pm .03$, and $10^6S_{22} = -1.43 \pm .03$. The other four harmonics in decreasing order of their estimated strength of absolute determination are: H_{32}, H_{44}, H_{33}, and H_{31}. Their normalized coefficients are found to be: $10^6C_{32} = 0.69 \pm 0.20$, $10^6S_{32} = -0.53 \pm 0.20$, $10^6C_{44} = 0.02$, $10^6S_{44} = 0.70$, $10^6C_{33} = 0.16$, $10^6S_{33} = 1.10$, $10^6C_{31} = -0.42$, and $10^6S_{31} = -1.58$. The measured drift accelerations themselves have been compared to accelerations calculated from a number of recently published satellite and combined satellite–surface gravity geoids. Author

N68-21936# Aeronautical Chart and Information Center, St. Louis, Mo.

ON THE DETERMINATION OF THE ORBITAL ELEMENTS OF A SATELLITE FROM THE POSITION AND VELOCITY COMPONENTS

M. Bursa Jan. 1968 18 p refs Transl. into ENGLISH from Studia Geophys. Geodaet., Ceskoslov. Akad. Ved. (Prague), v. 10, no. 4, 1966 p 401–410

(ACIC-TC-1339; AD-666322)

Orbital problems of satellite geodesy are based on the assumption that the geocentric orbital elements, giving the geocentric position of the satellite being observed, are known for the moment of observation. The determination of such elements, however, is possible only if the observed topocentric quantities were, with sufficient accuracy, reduced to geocentric ones. The reduction assumes, however, that the position of the satellite stations with respect to the center of mass of the earth is known. This, however, is not known and the determination of the geocentric positions is substantially the main problem of present-day geodesy. In the case of natural celestial bodies, relatively far from the basic body, inaccuracies in correcting for the parallax practically do not influence the solution. But in the case of near artificial earth satellites, these inaccuracies are not negligible. The present paper analyzes from this aspect the case when the orbital elements are calculated from one position (three coordinates) and three velocity components. Author (TAB)

N68-21947* Volt Technical Corp., Washington, D. C.

SYNTHESIS OF TRAJECTORIES AROUND THE MOON WITH RETURN TO THE EARTH ATMOSPHERE

V. A. Il'yin Greenbelt, Md. NASA 29 Apr. 1968 26 p refs
Transl. into ENGLISH from Zh. Vychislitel'noi Mat. (Moscow), v. 7, no. 2, 1967 p 367–388
(Contract NAS5-12487)
(NASA-CR-94237; ST-CM-10682) CFSTI: $3.00 CSCL 22C

An approximate method for the synthesis of flight trajectories around the Moon is presented. It is based on one of the possible simplified models of the gravitational field of the Earth–Moon system. This approximate method uses the concept of the possibility of approximate substitution of planet's gravitational field action upon the spacecraft by an impulse action, amounting to the rotation of spacecraft's velocity vector by a certain angle whereupon the radius of the sphere of action is assumed to be infinite relative to the planetocentrical motion, and zero relative to the heliocentrical motion. Relations are obtained for this scheme clearly linking the Earth–Moon and Moon–Earth trajectory parameters with the conditions of flight around the Moon. On the basis of the obtained relations an effective method was developed for a successive determination of the Moon–Earth and Earth–Moon flight parameters and of the selenocentric sector of motion. This method eliminates the numerical solution of any transcendental or algebraic equations above the second degree and, when the given conditions are consistent, makes it possible to unilaterally synthesize the flight trajectory around the Moon, taking into account the prescribed limitations. Author

N68-22030 California Inst. of Tech., Pasadena.

THE EAST-WEST STRUCTURE OF RADIO SOURCES AT 1425 MHZ

Edward Berel Fomalont (Ph.D. Thesis) 1967 287 p
Available from Univ. Microfilms: HC $13.05/MF $3.70 Order No. 67-3119

The east-west radio structures of 532 sources have been obtained with the Caltech variable spacing interferometer at a frequency of 1425 MHz. The visibility functions, measured at nine interferometer spacings between 144λ and 2626λ, are presented in tabular form for all of the sources. The east-west source structures were calculated by a model fit of the data or by a direct numerical inversion of the data. There are three major structure types: simple double, halo-core and triple. The simple double sources have two distinct components of emission having nearly equal intensities and diameters with the radio galaxy lying at the center of the two components in most cases. The halo-core sources consist of a small radio core, usually complex, coincident with the radio galaxy and a much larger region of emission, the halo, not necessarily symmetrically disposed aroung the radio core. The triple and more complex sources are discussed briefly. Dissert. Abstr.

N68-22046*# Wesleyan Univ., Middletown, Conn. Van Vleck Observatory.

[SEARCH FOR FAINT COMETS NEAR THE SUN DURING TOTALITY OF NOVEMBER 12, 1966, SOLAR ECLIPSE] Final Report

James Gibson 25 Mar. 1968 1 p
(Grant NGR-07-006-003)
(NASA-CR-94290) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Fixed-focus aerial cameras aboard a jet aircraft took a total of 110 exposures from the vicinity of the sun during total eclipse in a search for faint comets. However, no comets were recorded during exposures up to 1 second white light. Ten percent of the one second exposures, both in eclipse and on later night flights, were not affected by roll and demonstrated the validity of the experimental approach by recording field stars brighter than magnitude 3.0 with 1/25-second exposures during the eclipse. G.G.

N68-22056 California Inst. of Tech., Pasadena.

ATMOSPHERIC DYNAMICS IN A MODEL RR LYRAE STAR

John Irvin Castor (Ph.D. Thesis) 1967 180 p
Available from Univ. Microfilms: HC $8.20/MF $3.00 Order No. 67-3117

A dynamical model of an RR Lyrae star has been constructed which is similar to those of Christy in its treatment of the envelope interior to the hydrogen ionization zone but which describes the hydrogen ionization zone and the outer atmosphere in some detail. In the optically thin region heat transfer is described with the gray equation of radiation transfer which yields an integral expression for the heating rate, assuming small deviations from sphericity. The results have indicated a close connection between the complex hydrogen ionization zone dynamics and the observable phenomena in the star, such as rising branch shocks and the shape of the velocity curve during the decreasing light phase. Dissert. Abstr.

N68-22202*# Virginia Polytechnic Inst., Blacksburg.

TIME-OPTIMAL RENDEZVOUS FOR ELLIPTIC ORBITS

Y. Kashiwagi and K. T. Alfriend Washington NASA May 1968 125 p refs
(Grant NGR-47-004-006)
(NASA-CR-1036) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Time-optimal rendezvous maneuvers are studied. The system considered in this report consists of two space vehicles namely, a target vehicle (non-maneuvering vehicle) and an interceptor vehicle (maneuvering vehicle) under the influence of the earth gravity. An interceptor vehicle has propulsive jet systems which can produce a variable thrust (positive or negative) independently in three perpendicular directions. The case where the target vehicle is in the elliptic orbit is mainly considered and some analytical difficulties involved in the circular orbit case are discussed. Several time-optimal trajectories for different configurations are shown. Author

N68-22223 Lockheed Missiles and Space Co., Palo Alto, Calif.

SPACE VEHICLE CONTROL DURING ATMOSPHERIC REENTRY BY USING A VARIABLE STRUCTURE SYSTEM

N. S. Ukolov, E. A. Tiulin, and E. I. Mitroshin [1968] 7 p refs
Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 5, no. 6, 1967 p 857–862

Questions of synthesizing the control system for the motion of the center of a space vehicle are considered for controlling the motion relative to the nominal trajectory. A method is described for forming the switching line which would permit organizing the motion along incident trajectories. The influence of deviations in atmospheric characteristics from the standard is analyzed. Author

N68-22247*# Techtran Corp., Glen Burnie, Md.

SYNTHESIS OF THE ANALYTICAL RESULTS ON OPTIMAL TRANSFER BETWEEN KEPLERIAN ORBITS [SYNTHESE DES RESULTATS ANALYTIQUES SUR LES TRANSFERTS OPTIMAUX ENTRE ORBITES KEPLERIENNES]

Christian Marchal, Jean-Pierre Marec, and C. B. Winn Washington NASA Apr. 1968 36 p refs Transl. into ENGLISH of ONERA-TP-515 Rept. Presented at the 18th Congr. of the Intern. Astronautical Federation, Belgrade, 25–29 Sep. 1967
(Contract NASw-1695)
(NASA-TT-F-11590) CFSTI: $3.00 CSCL 22C

The optimization of the final mass depends upon the propulsion systems which are classified into two main categories: "high thrust systems" or, better, systems with an imposed exhaust velocity (chemical propulsion, nuclear rockets, etc...) and "low thrust systems" or, better, systems with an imposed exhaust power (nucleo-electric propulsion). The analytical resolutions utilize the classical optimization theories or more recent ones. They are classified into the "time-free" case, the "time-fixed" case (close orbits) and the studies of the "singular arcs"; the time-fixed case between distant orbits is almost always studied numerically. Author

N68-22248*# University of Southern Calif., Los Angeles. Electronic Sciences Lab.

MILLIMETER-WAVE RADIOMETRY FOR RADIO ASTRONOMY Final Report, Nov. 1965–31 Dec. 1967

W. V. T. Rusch, S. D. Slobin, and C. T. Stelzried Mar. 1968 78 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951756)
(NASA-CR-94314; USCEE-263) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Instrumentation development and measurements, and lunar eclipse observations made with the instrument are discussed. The radiometer noise and gain change measurements at various switching frequencies are described. Graphs of antenna characteristics include radiation patterns, noise spectra, and gain probability and switching frequency data. Emphasis is placed on a mathematical discussion of the scattering from an asymmetric hyperboloid. Radiometric measurements were made of the total lunar eclipse of 18 October 1967, and details are presented on the gain calibration, extinction curve, and data reduction. N.E.N.

N68-22253*# Harvard Coll. Observatory, Cambridge, Mass.

RECENT TECHNIQUES IN SOLAR OPTICAL ASTRONOMY FROM SPACE

E. M. Reeves Dec. 1967 28 p refs Presented at the 13th Gen. Assembly of the Intern. Astron. Union Prague, Aug. 1967
(Contracts NASw-184; NAS5-3949; NSR-22-007-067)
(NASA-CR-94365; TR-6) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Some of the recent advances in the techniques of solar space research, particularly over the last four years is presented, in an attempt to review the current state of instrument technology. The present state of development in rocket and satellite vehicles for solar observations, far ultraviolet detectors, optical materials, ultraviolet reflection coatings, filters, and photographic film fogging, are among the topics described. Author

N68-22260 Lockheed Missiles and Space Co., Palo Alto, Calif.

PROBLEM OF TWO-SATELLITE RENDEZVOUS IN ORBIT

M. K. Tikhonravov, I. M. Iatsunskii, G. Iu. Maksimov, I. K. Bazhinov, and O. V. Gurko [1966] 6 p Transl. into ENGLISH from Mashinostr. (Kiev), 1967 p 216–222 Submitted for publication

Introductory data are presented on the problems inherent in two-satellite rendezvous and docking. Five methods used to perform the rendezvous between two satellites launched from the same pad are briefly discussed, and of these, the case of two orbits with the same equatorial inclination and similar period and position of the nodes is examined. A system of differential equations (in an absolute coordinate system) is derived to describe the motion of both satellites by substituting the expressions for perturbing forces. Formulas are given for computing, with these equations, the power plant's thrust, satellite weight, fuel consumption per second, specific impulse, and the velocity corresponding to the magnitude of the impulse. E.J.S.

N68-22289*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SOME NUMERICAL COMPARISONS OF THREE-BODY TRAJECTORIES WITH PATCHED TWO-BODY TRAJECTORIES FOR LOW THRUST ROCKETS

William C. Strack Washington May 1968 30 p refs
(NASA-TN-D-4559) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The n-body problem for low-thrust vehicles with optimal thrust control is formulated for the case of constant thrust with coast. A successive two-body approximation to the n-body problem is also developed under the assumption of tangential thrust during the planetocentric leg. This approximation involves one arbitrary parameter—the planetocentric radius at the patch point—whose best value can be determined by comparison with n-body solutions. Numerical solutions of several three-body problems indicate that the patch radius should be about 300 earth radii for either a circular or a parabolic initial earth orbit. Author

N68-22319*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

AN ANALYSIS OF THE MARINER 4 PHOTOGRAPHY OF MARS

Clark R. Chapman, James B. Pollack, and Carl Sagan 14 Feb. 1968 89 p refs
(Grant NGR-09-015-023)
(NASA-CR-94358; SAO-SR-268) CFSTI: HC $3.00/MF $0.65 CSCL 03A

A catalog of nearly 300 craters and crater-like objects was prepared from several sets of contrast-enhanced high-quality positive transparencies of the Mariner 4 photography. Craters were identified and counted by the same procedures used in the compilation of lunar crater catalogs; particular attention was given to crater class and quality. Counts of craters with diameters D<20 km begin to show the effects of incompleteness. A direct inspection of the photographs as well as the constancy of crater class proportions with crater diameter interval above 20 km indicates that substantial erosion and obliteration of all but the largest craters have occurred during the history of Mars. The epochs of crater formation and crater erosion appear to be closely tied together in time. Author

N68-22332*# Army Map Service, Washington, D. C.

DEPARTMENT OF DEFENSE SELENODETIC CONTROL SYSTEM 1966

Jan. 1967 180 p
(NASA Order T-37794(G))
(NASA-CR-92078) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Three sets of data were combined to form the data for the adjustment. Each of the three sets was first adjusted independently for comparison on an equal basis prior to beginning the computations involving all data simultaneously. A least squares solution was performed to obtain the statistically most likely selenodetic coordinates of 734 craters, and a listing of the 734 points is included. The average point was measured on nine photographic plates. The rms horizontal and vertical uncertainties (precision) of the solution are ±972 and ±751 meters, respectively. The crater coordinates were compared point-by-point with other selenodetic systems. In each comparison, the rms differences, both horizontal and vertical, were less than the expected rms differences computed from the corresponding variances. Maximum rms differences approached ±1500 meters. Author

N68-22343# Lockheed Missiles and Space Co., Palo Alto, Calif.

HOME OF COSMONAUTICS

G. V. Petrovich 1967 13 p Transl. into ENGLISH from Vestn. Akad. Nauk SSR (Moscow), no. 10, 1967 p 54–62
(PB-177192T) CFSTI: HC$3.00/MF$0.65

A review of the space program of the USSR with references to the efforts of other nations. PB

N68-22355 Rensselaer Polytechnic Inst., Troy, N. Y.

A PHOTOMETRIC STUDY OF REFLECTION NEBULAE

Terry Paul Roark (Ph.D. Thesis) 1966 147 p
Available from Univ. Microfilms: HC $7.00/MF $3.00 Order No. 67-4194

The purpose of this investigation is to determine the physical properties of the scattering particles which constitute reflection nebulae. Theoretical models are constructed for plane-parallel slabs of scattering material. Exact Mie theory is used to calculate the scattering cross-sections for graphite, iron and dielectric spheres. The models thus constructed yield predicted nebular colors, on the UBV system, as a function of offset distance from the source of illumination. It is shown that no single physical or geometrical parameter will characterize any given color relation between the model and the star. The Maia, Merope and Alcyone nebulae in the Pleiades and NGC 7023 have been observed photoelectrically. The differences in both (B-V) and (U-B) colors between the illuminating star and points on the nebula were obtained. A comparison between the observed nebular colors and those predicted by the models indicates that the scattering particles in the nebulae do not behave as predicted for lossy spheres. Dissert. Abstr.

N68-22378*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.

AXIS OF THE ZODIACAL LIGHT AND THE CONSTANTS OF ITS PLANE OF SYMMETRY [DIE ACHSE DES ZODIAKALLICHTS UND DIE KONSTANTEN SEINER SYMMETRIEFLAECHE]

C. Hoffmeister Washington NASA Apr. 1968 60 p refs Transl. into ENGLISH of Astron. Nachr. (Berlin), v. 271, no. 2, 1941 p 49–67
(Contract NASw-1692)
(NASA-TT-F-11532) CFSTI: $3.00 CSCL 03A

On the basis of numerous observations by himself and others, the author begins by investigating the disturbances which affect the axis of the zodiacal light owing to atmospheric extinction, twilight, atmospheric skylight and the Milky Way. A portion of the disturbing factors can be overcome by corrections. Where this is not possible, the magnitude of the disturbance is measured so that its influence on the data can be estimated. The best possible position of the light axis, extended over all seasons of the year, can then be used for a new determination of the constants of the plane of symmetry, as previously defined in an earlier paper. The authors previous values of the constants, based primarily on observations by Jones, are generally confirmed and occasionally improved. A detailed description of the contents of the paper is to be found in the last section. Author

N68-22387*# Volt Technical Corp., Washington, D. C.

MICROMETEORIC INVESTIGATIONS ABOARD AES KOSMOS 135 [MIKROMETEORNYYE ISSLEDOVANIYA NA SPUTNIKE KOSMOS 135]

B. P. Konstantinov, M. M. Bredov, E. P. Mazets, V. N. Panov, R. L. Aptekar et al Washington NASA 6 May 1968 19 p refs Transl. into ENGLISH from Russian
(Contract NAS5-12487)
(NASA-CR-94335; ST-IM-10710) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The investigations of the dust component of outer space medium by acoustic method have resulted in the representations of high dust concentration in the near-Earth space and in the hypothesis based upon the existence in it of an Earth's dust cloud. It is established in the present work that when using the acoustic method, there is a great danger in the appearance of ghost signals occurring in detectors and satellite constructions as the temperature regime changes. The sources of interferences are investigated and the instrumentation is worked out with low noise level. The magnitude of the flux of dust particles with mass of $2 \cdot 10^{-9}$ g constitutes $7.5 \cdot 10^{-6}$ particle/m^2 sec. This value is 10^3 times lower than those obtained in previous experiments carried out by the acoustical method, in the course of which the danger of thermal noise appearance was not taken into account. The corrections of experimental data provided by measurements aboard AES "KOSMOS-135" render the hypothesis about the existence of a dust cloud around the Earth quite obsolete. Author

N68-22466*# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.

A STUDY TO DETERMINE OPTIMUM LUNAR LIGHTING CONDITIONS FOR VISUAL SELECTION OF LEM TOUCHDOWN POINT Final Report, 12 Oct. 1965–15 Aug. 1966

Tsun-Ying Feng Jan. 1967 99 p refs
(Contract NAS9-5321)
(NASA-CR-92077; SSD-60293R) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A study designed to determine optimum lighting and viewing geometry for the visual evaluation and selection of a LEM landing point within a predetermined landing area is reported. Test objectives included the following tasks: lighting conditions analysis; human factors evaluation and analysis; optical aids analysis; and simulation program. The most significant results of these studies were: (1) the adequacy of the background light resulting from the lunar lighting condition analysis, and (2) the lunar obstacle detection ranges at various sun angles and viewing geometries, from the experimentally determined predictions in the simulation program and the literature based predictions in the human factors evaluation and analysis. On the basis of these two results, optimum and acceptable lighting conditions and viewing geometries for selection of the LEM touchdown point during the terminal phase of the LEM landing approach are recommended. LEM trajectory alteration and optimum search strategy is discussed and pertinent simulation research supplemental to the program in visual selection of the LEM landing site is outlined. S.C.W.

N68-22470*# New York Univ., N. Y. Dept. of Meteorology and Oceanography.

COMMENTS ON THE PAPER BY D. G. REA AND B. T. O'LEARY ON THE COMPOSITION OF THE VENUS CLOUDS

James E. Hansen and Howard Cheyney May 1968 7 p refs
(Grant NsG-399)
(NASA-CR-94364) CFSTI: HC$3.00/MF$0.65 CSCL 03B

In a recent paper Rea and O'Leary (1968) examined the cases for and against ice clouds on Venus and concluded that there is no direct evidence for H_2O ice crystals and that if they do exist and dominate the near infrared scattering process, they must be submicron in diameter. This paper points out that with micron sized ice particles as the major scatterers, the reflectivity minima near 1.5 and 2.0 microns are not generally as large as assumed by Rea and O'Leary. Although the evidence presented for ice clouds on Venus is not positive proof, it demonstrates that arguments against clouds of micron sized ice crystals are not yet conclusive. R.N.A.

N68-22480# Joint Publications Research Center, Washington, D. C.

ASTRONOMY

In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 179 6 May 1968 p 1–8 refs (See N68-22479 12-13)

News releases and abstracts of Soviet bloc research in astronomy are presented. Activities at an astrophysical institute and at a cosmic radiation research facility are summarized; comments are made on newly detected signals from space; and news of the motion of Taurus stars, Venus clouds, and lunar and planetary study is reported. Scientific abstracts deal with radar observations of Geminids, albedo differences on the moon, gamma radiation of the moon and composition of lunar rocks, and the lunar eclipse of Taurus A. An optical model of the Martian atmosphere, image blurring effects on solar spectrum line form and intensity, determination of Li line 6103.34 Å in sunspot spectra, formation of absorption lines in a magnetic field, and the solar eclipse of May 22, 1966 are discussed. The application of averaging methods to differential equations of restricted problems is considered. M.W.R.

N68-22567*# National Aeronautics and Space Administration, Washington, D. C.

ASTROPHYSICAL PHENOMENA AND RADIOCARBON

B. P. Konstantinov and G. E. Kocharov Apr. 1968 36 p refs Transl. into ENGLISH of the publ. "Astrofizicheskiye Yavleniya i Radiouglerod" Leningrad, Fiz.-Tekhn. Inst. Im. A.F. Ioffe, 1967 p 1–43
(NASA-TT-F-11567) CFSTI: $3.00 CSCL 03B

Consideration is given to an expansion of the basic relationships between astrophysical phenomena and radiocarbon. Determination of the radiocarbon content in dendrochronologically dated samples is used to study solar cyclic activity, flares from supernovae, etc. In addition, the atmospheric C^{14} concentration can be used to determine the characteristic times for C^{14} dispersion into various reservoirs. Author

N68-22634*# Aztec School of Languages, Inc., Acton, Mass.

PLAN OF OPERATIONS—FEBRUARY 1968. GEODESY PROGRAM RCP 133

Washington NASA Apr. 1968 36 p Transl. into ENGLISH of the publ. "Plan d'Operations 2/68, Campagne de Geodesy RCP 133" Paris, Centre Natl. d'Etudes Spatiales, Feb. 1968 p 1–45
(Contract NASw-1692)
(NASA-TT-F-11657) CFSTI: $3.00 CSCL 22A

An organizational plan is presented on a geodetic satellite observation program being undertaken to relate the African system of coordinates to the European system. Photographic devices and cameras are to be used for obtaining the α and δ data from photographs of flashes emitted by the GEOS B satellite and from photographs made of the light reflected by the passive satellites. Laser telemetry stations are to furnish data on the distance of these satellites on the photographed arcs; a list of the participating stations is included. Coordination procedures are discussed, along with data transmission and processing schedules. M.G.J.

N68-22685*# California Inst. of Tech., Pasadena.

SUPERNOVAE EXPLOSIONS INDUCED BY PAIR PRODUCTION INSTABILITY

Gary S. Fraley Mar. 1968 36 p refs
(Grant NsG-426)
(NASA-CR-94422) CFSTI: HC$3.00/MF$0.65 CSCL 03B

Stars with a core mass greater than about 30 $M_{\odot}$ become dynamically unstable due to electron–positron pair production when their central temperature reaches $1.5–2.0 \times 10^9$ °K. The collapse and subsequent explosion of stars with core masses of 45, 52, and 60 $M_{\odot}$ is calculated. The range of the final velocity of expansion (3,400–8,500 km/sec) and of the mass ejected (1–40 $M_{\odot}$) is comparable to that observed for type II supernovae. A dynamical model of convection is derived and included in the calculations. It was found that the effect of the convection on the explosions is probably not important. Author

N68-22768*# Massachusetts Inst. of Tech., Cambridge. Soil Mechanics Div.

LUNAR SOIL MECHANICS

Apr. 1968 115 p refs
(Grant NsG-496)
(NASA-CR-94424) CFSTI: HC$3.00/MF$0.65 CSCL 22A

A study on lunar soil mechanics is presented with the purpose of delineating the contributions that soil engineering can make in lunar exploration, and to indicate the research needed to cope with lunar soil engineering problems. The three objectives are (1) to identify those problems that require soil mechanics for their solution, (2) to identify the parameters and analytical techniques needed to solve these problems, and (3) to propose a lunar soil mechanics research program that will contribute to the solution of the soil engineering problems. Soil mechanics problems involved in lunar exploration are discussed in relation to stability and mobility. The stability problem involves support of structures on lunar surface, soil and vehicle modifications, and stability of lunar modules. The mobility problem deals with the ability of a vehicle to move about on the surface of the moon. The recommended research program has as its objective the remote prediction of site performance for foundation and mobility problems prior to astronaut landing. The feasibility of analytical research on foundation land mobility is also considered. Details are given on examples and solutions to soil mechanics problems. B.S.D.

N68-22844# Sandia Corp., Albuquerque, N. Mex.

A CLOSED FORM APPROXIMATE SOLUTION FOR THE INITIAL REENTRY ANGLE AND VELOCITY OF OBJECTS DECAYING FROM CIRCULAR ORBITS AROUND AN OBLATE ROTATING PLANET (EVALUATED FOR EARTH FOR SIX ATMOSPHERIC MODELS)

H. R. Spahr Oct. 1967 240 p refs
(SC-RR-67-123) CFSTI: HC$3.00/MF$0.65

A closed form approximate solution was developed and used to calculate the initial reentry angle and velocity for objects decaying from earth orbits. This solution includes the planet's rotation, its oblateness, and the second harmonic in its gravitational field. The variables for which the reentry angles and velocity are calculated include altitude, orbital inclination, latitude, and atmospheric models. The ballistic coefficient dependence is eliminated by presenting the product of ballistic coefficient and drag reentry angle. The closed form approximate solution is compared, for several cases, with "exact" solutions obtained by the numerical integration of the differential equations of motion. These comparisons define the region of validity for the approximate closed form solution. Author (NSA)

N68-22851# Sandia Corp., Albuquerque, N. Mex.

COMPUTER CODE HRS004: A CODE FOR THE COMPUTATION OF THE INITIAL REENTRY ANGLE AND VELOCITY OF OBJECTS DECAYING FROM EARTH ORBIT

H. R. Spahr Dec. 1967 143 p refs
(SC-RR-67-858) CFSTI: HC$3.00/MF$0.65

Computer Code HRS004 calculates the initial reentry angle and velocity of objects decaying from circular orbits around a rotating oblate Earth using a closed form approximate solution. The variables for which the reentry angles and velocities are calculated include altitude, orbital inclination, latitude, and atmospheric model. The ballistic coefficient dependance is eliminated by presenting the product of ballistic coefficient and drag reentry angle. The six versions of this code are discussed in detail. Sample atmospheric data input and output results are presented and discussed. Author (NSA)

N68-22860*# St. Louis Univ., Mo.

RADIATIVE HEATING AND COOLING FUNCTIONS FOR THE LOWER MARTIAN ATMOSPHERE UNDER THE CONDITION OF LOCAL THERMODYNAMIC EQUILIBRIUM (LTE)

Albert J. Pallmann Washington NASA May 1968 47 p refs
(Grant NGR-26-006-016)
(NASA-CR-1044; Rept.-101) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The physics of planetary radiation fields has been reexamined to derive formulas describing analytically the heating and cooling processes of the Martian atmosphere in local thermodynamic equilibrium (LTE). The computational algorithm required for the numerical solution of the radiative heating and cooling in the Martian atmosphere has been outlined. Spectral data for near and far IR CO_2 bands have been provided. A model was assumed for the Martian atmosphere in LTE, characterized by 100% CO_2, plane-parallel stratification, with no particulates embedded, scattering by molecules excluded, and neglecting the reflection of solar radiation at the ground. However, radiative equilibrium has not been assumed, because this assumption would have made the heating and cooling rates identically zero. The radiative transfer theory, its computational algorithm, and the spectral data of CO_2 and solar radiation for the Martian atmosphere, as presented in this paper, provide the means for computing the radiative heating and cooling rates for the atmosphere of Mars at any latitude, once the temperature sounding is given for the location. Author

N68-22885*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ON THE APPLICATION OF SPINORS TO THE PROBLEMS OF CELESTIAL MECHANICS

Karl Stumpff Washington May 1968 44 p refs
(NASA-TN-D-4447) CFSTI: HC $3.00/MF $0.65 CSCL 03C

Since Newton, the stumbling-block in celestial mechanics was the three-body problem. Only restricted cases have yielded solutions. This paper describes a new tool for solving the perturbation problem—"spinors," a vectorial concept (in the complex plane) originally used in atomic physics but now applied to celestial mechanics. The two-body problem is discussed and two devices are introduced: "pseudo-time" and the Levi-Cività transformations. Then spinors are shown to make possible the extension of these transformations to three dimensions. Perturbation problems are discussed; notably a body moving around the sun and being acted on by the orbital motion of a major planet. Author

N68-22922*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GRAVITY ASSIST OPTIMIZATION TECHNIQUE APPLICABLE TO A VARIETY OF SPACE MISSIONS

B. Kaufman, C. R. Newman, and F. Chromey Aug. 1966 31 p refs
(NASA-TM-X-63179; X-507-66-373) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Six different free fall missions that utilize the gravitational influence of a passing planet are presented. The missions are: minimum flight time for deep space probes, maximum inclination out of the ecliptic, maximum component of the velocity normal to the ecliptic, maximum distance out of the ecliptic within a specified time, minimum closest approach to the sun, and attaining a specific value of perihelion. Any mission objective that can be defined as a function of the heliocentric orbital parameters may also be treated. An iterative procedure is used to optimize the post encounter orbit for the desired mission. The patched conic assumption is used in that the actual flight path of a free fall vehicle is approximated by conic trajectories in finding the post encounter trajectory. Examples are included of missions utilizing the gravitational influence of the planet Jupiter. Without using Jupiter for an assist such missions would be difficult to perform with our present technology. Author

N68-22932*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE APPROXIMATION OF STELLAR ENERGY DISTRIBUTIONS AND MAGNITUDES FROM MULTI-COLOR PHOTOMETRY

Paul B. Davenport Apr. 1968 17 p refs
(NASA-TM-X-63185; X-542-68-120) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A procedure is developed for approximating the energy distribution of a star from present day multicolor photometry. This approximation is then used to predict stellar magnitude relative to a light sensitive device with known spectral response. Using magnitudes in the U, B, V system it is found that the energy distributions of stars can be approximated by this procedure fairly accurately over the range of 3000–8000 angstroms. The stellar magnitude relative to a sensor whose dominant response lies in this region can then be determined with an accuracy of about 0.1 magnitude. Author

N68-22933*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

THE VOYAGER PLANETARY QUARANTINE MODEL 1973 MISSION

Robert G. Chamberlain 1 Jun. 1967 32 p refs
(Contract NAS7-100)
(NASA-CR-94387; JPL-TM-33-252) CFSTI: HC $3.00/MF $0.65 CSCL 22A

This Memorandum presents the framework of a model which treats all elements of the *Voyager* 1973 Mission in sufficient detail to allow reasonable assurance that the *Voyager* policy on planetary quarantine can and will be adhered to by the *Voyager* Project. The *Voyager* 1973 Mission is examined from the point of view of planetary quarantine in order to isolate every conceivable source of contamination of the planet Mars. These sources are being studied in detail in order to ascertain the requirements that must be met by the hardware and mission designs in order to satisfy the constraints imposed by the planetary quarantine policy. Author

N68-22994*# Avco Corp., Lowell, Mass. Space Systems Div.

VENUS FLYBY/ENTRY PROBE MISSION STUDY, 1972. BOOK 1: SUMMARY, INTRODUCTION, MISSION DEFINITION, ENTRY PROBE SYNTHESIS Final Technical Report

Apr. 1968 772 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951964)
(NASA-CR-94406; AVSSD-080-68-RR, Bk. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Technical details are given on the various concepts of a flyby/entry probe system for the 1972 Venus launch and the three candidate missions that were evolved, with the objective being to define the mission, flyby and entry probe system and subsystems, and to evaluate the program and technology requirements. The study objectives, guidelines, and plans are delineated, and the system requirements of each mission are defined. The mission definition is summarized in relation to mission reliability requirements and constraints, encounter geometry requirements, transfer trajectories to Venus, and the best occultation transfer trajectory selection. The entry probe system constraints and requirements are discussed along with entry probe configurations, the flight sequence, and aerodynamics. The functional requirements and a description of the heat shield, structure, payload module, and sterilization canister subsystems are given. B.S.D.

N68-23032*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

SMITHSONIAN CONTRIBUTIONS TO ASTROPHYSICS, VOLUME 10, NUMBER 3: METEOR MASSES AND LUMINOSITY

Franco Verniani Washington 1967 18 p refs
(Contract NSR-09-015-033)
(NASA-CR-94396) GPO: HC $0.20; CFSTI: MF $0.65 CSCL 03B

A previously published study of the meteor luminous efficiency improves the accuracy of the previous data and takes better account of fragmentation. Most of the meteors, both sporadic and shower, have an average density of about 0.2 g cm^{-3}; although the few sporadic meteors with very short orbits, which have densities of about 1 g cm^{-3}, are considered to represent a very small minority of cometary meteors. Velocity dependence of luminous efficiency is discussed, and the luminosity coefficient is evolved. Density distributions are plotted for some meteor groups, and average densities are tabulated for Super-Schmidt shower meteors. M.W.R.

N68-23036# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINATION OF THE GRAVITATIONAL FIELD OF THE MOON BY THE MOVEMENT OF THE ARTIFICIAL MOON SATELLITE LUNA-10 [OPREDELENIYE POLYA TYAGOTENIYA LUNY PO DVIZHENIYU ISKUSSTVENNOGO SPUTNIKA LUNY LUNA-10]

E. L. Akim 9 Aug. 1967 13 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 170, no. 4, 1966 p 799–802
(FTD-HT-67-50; AD-666737)

To determine the noncentral gravitational field of the Moon, the motion of the artificial Moon satellite Luna 10 is analyzed with gravitational forces of the Earth and the Sun taken into account. From the statistically processed measurements of the trajectory of Luna-10 carried out over the period of its existence (from April 3 to May 30, 1966), it is established that the effect of noncentrality of the gravitational field of the Moon is an essential factor in the evolution of the orbit of Luna-10. The perturbations of its circumlunar orbit due to noncentrality of the gravitational field of the Moon are particularly noticeable in the evolution of the longitude of the ascending node and the angular distance of the pericenter to the ascending node. The perturbations of elements and of Luna-10 during the time of its existence (460 revolutions) due to noncentrality of the gravitational field of the Moon and due to gravitational effects of the Earth and the Sun (the gravitational effects of other planets are neglected) are presented as functions of the number of revolutions of the Moon satellite. A comparison of the results shows that perturbations for Luna-10 due to noncentrality of the gravitational field of the Moon exceed the perturbations due to gravitational forces of the Earth and the Sun 5 to 6 times. Author (TAB)

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N68-21910*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

APOLLO/SATURN 5: FLIGHT READINESS TEST

J. N. Bardwell 22 Sep. 1967 106 p
(NASA-TM-X-61054; SD-40002) CFSTI: $3.00 CSCL 22B

Procedures and equipment for the Apollo/Saturn V Flight readiness test are presented. The test will be performed with the space vehicle in launch configuration except for use of minimum amount of OAT equipment required for performance of the test. The spacecraft will complete a compressed mission simulation with the launch vehicle completing a full duration simulation. B.S.D.

N68-21925*# National Aeronautics and Space Administration, Washington, D. C.

ESRO 2-B

30 Apr. 1968 15 p
(NASA News Release-68-75) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A press kit details the proposed cooperative launching of the 164-lb ESRO 2B satellite by the European Space Research Organization and NASA. Built under the direction of the 10-nation ESRO, the spacecraft was to carry seven scientific experiments to study solar and cosmic radiation. It was to be launched by a four-stage Scout rocket vehicle into a sun-synchronous polar orbit with perigee of 215 statute miles and apogee of 680 miles, and with a planned orbital period of 98 min at an inclination to the equator of 98 deg. M.W.R.

N68-21928*# Philco-Ford Corp., Newport Beach, Calif. Space and Re-Entry Systems Div.

ANALYSIS OF CONCEPTUAL DESIGNS FOR THE VOYAGER ENTRY CAPSULE

Gerald A. Cohen, Richard M. Foster, and Everett M. Schafer [1968] 192 p refs
(Contract NAS1-5554-1)
(NASA-CR-66580) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Entry trajectories were computed for 10 ft base diameter blunt cone and tension shell capsules with ballistic coefficients of approximately 0.2 $slug/ft^2$. In order to simulate the most severe conditions expected, entry was assumed to follow an attitude control failure resulting in uncontrolled tumbling at an initial rate of 0.1 rad/sec. From two sets of entry conditions and four model atmospheres, two critical trajectories are presented for each capsule. One provides critical time-integrated heating loads; the other, critical pressure loads and heating rates. From the results of the trajectory study, critical aerodynamic pressure distributions were analytically determined for each capsule configuration. Using the critical pressure distributions obtained in the flow field analysis, the elastic stress response and stability of the conical sandwich shell and skin-stiffened tension shell capsules were analyzed. Both 15 and 19 ft base diameters were considered for capsules with ballistic coefficients of approximately 0.2 $slug/ft^2$. Structural design changes were made until acceptable (but not necessarily optimum) designs were achieved for both types of capsules. For the final designs, fundamental natural frequencies and vibration mode shapes were determined. Author

N68-21929# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.

KINETHEODOLITE OBSERVATIONS MADE AT EARLYBURN SATELLITE 1965–95 B, JANUARY TO MARCH 1966

12 Sep. 1967 12 p refs
(ROE-STS-63) CFSTI: HC $3.00/MF $0.65

Observations made with the Earlyburn cinetheodolite are given in fully reduced form for seven transits of satellite 1965–95 B from January to March 1966. Author (ESRO)

N68-21930# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.

KINETHEODOLITE OBSERVATIONS MADE AT EARLYBURN SATELLITE 1962 BETA-TAU 6; OCTOBER 1965 TO MARCH 1966

4 Aug. 1967 40 p refs
(ROE-STS-62) CFSTI: HC$3.00/MF$0.65

Observations made with the Earlyburn cinetheodolite are given in fully reduced form for 35 transits of satellite 1962 beta-tau 6 from October 1965 to March 1966. Author (ESRO)

N68-21934*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SURVEYOR 5 MISSION REPORT. PART 1: MISSION DESCRIPTION AND PERFORMANCE

15 Mar. 1968 240 p refs
(Contract NAS7-100)
(NASA-CR-94251; JPL-TR-32-1246) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Surveyor V was launched from Cape Kennedy, Florida, on September 8, 1967. All established objectives for the mission were achieved. Several extra midcourse corrections were performed during the transit phase in an attempt to correct a helium leak in the vernier propulsion pressurization system. Although the leak persisted, a completely successful soft landing was achieved in the Sea of Tranquility by modifying the terminal descent sequence during the flight. Surveyor V performed extensive operations before shutdown after sunset of the first lunar day and also was opprated the second and fourth lunar days. A large quantitity of television pictures and other new data were provided on the inside of a small crater in which the spacecraft landed and the relatively level mare surface visible surrounding the crater. Of special interest are the results obtained by an alpha scattering instrument, which provide the first direct information on the chemical composition of the moon. Unique results were also obtained on this mission from a postlanding vernier engine static firing, which produced lunar surface erosion, and from a test of the lunar surface magnetic properties using a bar magnet. Author

N68-21946*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

DEVELOPMENT OF ACOUSTIC TEST CONDITIONS FOR APOLLO LUNAR MODULE FLIGHT QUALIFICATION

Wade D. Dorland, Robert J. Wren, and Kenneth McK. Eldred Mar. 1968 29 p refs
(NASA-TM-X-58016) CFSTI: HC$3.00/MF$0.65 CSCL 22B

An acoustic test of an Apollo lunar module was performed prior to flight to verify structural and component integrity. Since the lunar module is enclosed within a spacecraft/lunar-module adapter during the first-stage boost when the dynamic-pressure environment is encountered, the test was performed in accordance with criteria based on measurements of spacecraft/lunar-module-adapter vibration response. In the lunar-module qualification test, the acoustic spectrum imposed on the spacecraft/lunar-module adapter was nearly as predicted for frequencies above 315 Hz; whereas, the low-frequency spectrum contained more energy than had been predicted. The measured spacecraft/lunar-module adapter responses provided an excellent fit to the flight enevelope. Author

N68-22024*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

COMPUTATION OF TORSIONAL VIBRATION MODES OF RANGER AND SURVEYOR SPACE VEHICLES

J. A. Garba, W. H. Gayman, and B. Wada 1 Apr. 1968 72 p refs
(Contract NAS7-100)
(NASA-CR-94293; JPL-TM-33-277) CFSTI: $3.00 CSCL 22B

Mathematical models are synthesized to apply to the calculation of "free-free" torsion modes of two space vehicles: the *Atlas/Agena/Ranger* (Block III) and the *Atlas/Centaur/Surveyor*. Input data describing the launch vehicles are obtained as lumped-parameter systems. Spacecraft descriptions are obtained in normal-mode corrdinates from modal vibration surveys. A simple technique for deriving compatible coordinate systems is applied. Calculated modal data are presented for both space vehicles. This work was conducted to provide normal-mode data for use in the synthesis of a torsional acceleration transient for Surveyor spacecraft vibration qualification tests. Author

N68-22060# General Electric Co., Philadelphia, Pa. Space Technology Center.

DYNAMIC ANALYSIS OF LARGE SPACE VEHICLE SYSTEMS

Yi-yuan Yu Apr. 1967 43 p refs
(Rept.-67-SD-235)

The method of determining the dynamic response of a large system from the characteristics of its subsystems is explored for application to space vehicle systems. The basic problem is that of joining together two subsystems (which may, for instance, simulate the spacecraft and the launch vehicle) or that of joining two components within a subsystem. By starting with Hamilton's principle or a continuous elastic solid and employing the usual modal analysis, the receptance of a component or subsystem is determined analytically. Results for discrete models are similar. From the receptances of the subsystems, the receptances of the composite system are calculated, and responses to periodic, transient, or random excitations may finally be determined. Extension to more than two subsystems or components is immediate. The receptances are further useful in control-interaction and static analyses of the system. Damping may also be incorporated. Author

N68-22213*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

CHEMICALLY INDUCED IGNITION IN AIRCRAFT AND SPACECRAFT ELECTRICAL CIRCUITRY BY GLYCOL/WATER SOLUTIONS

W. R. Downs Washington Apr. 1968 17 p refs
(NASA-TN-D-4327) CFSTI: $3.00 CSCL 22B

Electrical circuitry of military aircraft and spacecraft consists, in part, of insulated silver-covered copper wires and components. This circuitry creates a potential flammability hazard when solutions of glycol/water come in contact with either a bare or a defectively insulated wire or component carrying direct current. The hazard arises from chemical reactivity of the silver-covered copper anode in contact with glycol/water solutions. Similar reactivity does not occur with pure copper, nickel-covered copper, or tin-plated copper elements in electric circuits. Some chemical and physical properties of glycol/water fluids are presented, and glycol-induced corrosion of metals and corrosion inhibitors are discussed. A tentative chemical mechanism for the reactions of glycol/water solutions with silver wire carrying direct current is proposed. Author

N68-22262*# National Aeronautics and Space Administration, Washington, D. C.

RUSSIAN ROCKETRY, A HISTORICAL SURVEY

I. A. Slukhai 1968 152 p refs Transl. into ENGLISH of the publ. "Rakety i Traditsii" Moscow, Voennoe Izd. Min. Oborony SSSR, 1965 Published by Israel Program for Sci. Transl. for NASA and NSF
(NASA-TT-F-426; TT-67-51363) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The contribution of Soviet scientists and designers to rocket technology is recounted. Pre- and post-World War 2 activities are discussed, with emphasis placed on the role of the rocketeer in the Army, Air Force, and Navy. Space exploration achievements are noted, along with the use of meteorological rockets for studying the upper layers of the atmosphere. M.G.J.

N68-22301*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DYNAMIC STABILITY OF A 4.6-METER DIAMETER 120° CONICAL SPACECRAFT AT MACH NUMBERS FROM 0.78 TO 0.48 IN A SIMULATED MARTIAN ENVIRONMENT

Charles H. Whitlock and Richard J. Bendura Washington May 1968 28 p refs
(NASA-TN-D-4558) CFSTI: HC$3.00/MF$0.65 CSCL 22B

Subsonic dynamic stability characteristics of the spacecraft were determined from flight data in a simulated Martian environment. The results cover a Mach number range from 0.78 to 0.48, and a Reynolds number range from 200,000 to 100,000 (based on 15-foot (4.6 meter) spacecraft diameter). Assumptions of the analysis include linear static aerodynamics and invariant dynamic stability derivative $C_{m_q} + C_{m_\alpha}$, with angle of attack. Reduction of the data on a cycle-by-cycle basis gives $C_{m_q} + C_{m_\alpha}$, values near −0.135 with an uncertainty of ±0.105 over the range of the test. Trajectory simulation studies indicate that a reasonable simulation can be obtained by using a damping coefficient of −0.135, and that ±0.105 is a realistic value for the accuracy limit. Author

N68-22339*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

INSTRUMENTATION AND FLIGHT REPORT ON STROBEE 1500 FLIGHT 16.02 GT

C. D. Tackett Feb. 1968 155 p
(NASA-TM-X-63174; X-721-68-66) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The functions of the National Aeronautics and Space Administration GSFC Sounding Rocket Instrumentation Section in support of the Astrobee 1500 Flight 16.02 GT, launched from Wallops Island on 21 October 1964 are described. The primary purposes of this heavily instrumented flight were to evaluate rocket performance and payload environment, in addition to verifying design changes incorporated as a result of unsuccessful Flight 16.01 GT. Specifically, the basic flight objectives were to: (1) Confirm the performance of the Astrobee 1500 rocket, and the operation of vehicle subsystems, in order to assess their usefulness in the sounding rocket program. (2) Define the flight environment to which the payload will be subjected, including: interior tempratures, sustained longitudinal and lateral acceleration, and vibrational and rotational accelerations. (3) Determine second stage tipoff and its resulting dispersion. Author

N68-22354 Lockheed Missiles and Space Co., Sunnyvale, Calif.

INFLUENCE OF EXTERNAL PERTURBING MOMENTS ON THE DYNAMICS OF A SINGLE AXIS ORIENTATION SYSTEM FOR A SPACE VEHICLE WITH ONE FLYWHEEL

A. A. Karymov and T. V. Kharitonova 1967 12 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 31, no. 6, 1967 p 1095–1103

Stability of free oscillations of a flying vehicle with a flywheel having a moving axis, the motion of the oriented axis subjected to external perturbing moments, and the perturbed motion of the vehicle relative to the oriented axis are considered. Fundamental equations for unperturbed motion are given, and a system of sun-tracking system axes is discussed. It is shown that at the termination of the transient in the unperturbed motion, the longitudinal axis of the vehicle is not exactly coincident with the direction of the sun. Perturbed motion of the oriented axis is discussed, and the case of a circular orbit is considered along with the necessary equations to effect a solution. The considered system with periodic coefficients is found to have no stable periodic solution, and a sequential approximation method is evolved to determine the stability of the motion. The steady motion mode of a space vehicle around the oriented axis and with a small external force moment is discussed. M.W.R.

N68-22516# Lockheed Missiles and Space Co., Palo Alto, Calif.

DOCKING IN SPACE—A COMPLEX PROBLEM

Iu. Novikov and B. Fedorov [1968] 6 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 1, 1968 p 53–56

Automatic docking of space vehicles is discussed, mention is made of Cosmos 186 and 188 satellites, and the simultaneous injection of more than one space vehicle is considered. Problems associated with automatic docking are noted, and the need for complex radio equipment and computers is stressed. A block diagram is included of the active vehicle control for automatic docking. M.W.R.

N68-22551# Lockheed Missiles and Space Co., Palo Alto, Calif.

TASS REPORT: AUTOMATIC DOCKING OF "COSMOS-212" "COSMOS-213"

21 Apr. 1968 9 p Transl. into ENGLISH from Pravda (Moscow), no. 112 (18159), 21 Apr. 1968

A narrative report considers spacecraft docking in general and the automatic docking of the Cosmos 212 and 213 satellites in near-earth orbit. The motion control system and its components are discussed and details are included of the actual docking procedure. M.W.R.

N68-22641* Boeing Co., Seattle, Wash.

ANALYSIS OF FLIGHT PROBLEMS—LUNAR ORBITER

J. R. Prentice and R. H. Daly 1968 354 p
(Contract NAS1-3800)
(NASA-CR-66583; D2-100807-1) CFSTI: $3.00 CSCL 22B

The problems that were encountered during Lunar Orbiter Missions I, II, III, IV and V are presented, including all spacecraft and certain ground equipment problems that occurred during launch and prelaunch. Each problem presentation includes flight operational history, engineering analysis, relationship to other ground test and/or flight problems, and corrective action. The flight operational history includes a description of the problem, data of discovery, how the problem manifested itself, the effect on mission accomplishment and operational work-arounds. The engineering analysis contains a detailed analysis of each problem, the history of the affected item, and the rationale used for arriving at conclusions. The relationship of the anomaly to ground test and flight experience is discussed. The corrective action taken to prevent recurrence of each problem is indicated. Comments on the effectiveness of the corrective action as verified by operation in subsequent mission or ground tests are included. Author

N68-22742*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

WIND TUNNEL INVESTIGATION OF FLUCTUATING PRESSURES ON A 1/10-SCALE CENTAUR MODEL AT TRANSONIC SPEEDS

Bernard J. Blaha Washington May 1968 19 p refs
(NASA-TM-X-1574) CFSTI: HC$3.00/MF$0.65 CSCL 22D

Wind tunnel tests of a 1/10-scale Centaur model with a Surveyor nose cone were conducted over a range from Mach 0.55 to 1.95 to determine amplitudes and frequencies of fluctuating pressures that exist on the model surface at these speeds. Tests were conducted for roll angles of 0°, 90°, and 180° at 0° angle of attack. Peak-to-peak fluctuating pressure levels up to 30 percent of tunnel dynamic pressure were measured immediately downstream of the cone shoulder, the umbilical island, and on the boost pump fairing. Background noise in the tunnel made a detailed frequency analysis impractical. Author

N68-22772*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

MECHANICAL VIBRATION TRANSMISSION IN THE MARINER 69 SPACECRAFT Interim Progress Report

14 Jul. 1967 41 p refs Prepared for JPL
(Contract NAS7-100)
(NASA-CR-94399) CFSTI: HC$3.00/MF$0.65 CSCL 22B

An analytical procedure for estimating vibration transmission in the Mariner 1969 spacecraft assembly is presented. The method, based on statistical energy analysis techniques, considers the following elements: (1) the Centaur tank-dome or alternatively the vibration test fixture, (2) the adapter stiffners, (3) the ring frame, and (4) the spacecraft electronic-assembly panels. These techniques, which are only applicable when several vibration modes occur in the analysis frequency band, yield predictions of the mean-square vibration response averaged over a frequency band and a uniform spatial region. Analytical predictions of acceleration functions for the different elements are compared with octave band measurements of the transfer functions, and the space-average, mean-square acceleration responses are calculated as a function of frequency. Power balance equations relating the response of adjacent elements of the spacecraft model are formulated, and the model densities are discussed. Calculations for the coupling loss factors are given along with the acceleration response ratios for the structural elements. The results of an analytic and experimental study of vibration transmission between two plates is also presented. B.S.D.

N68-22953*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
STATIC LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF SEVERAL CONFIGURATIONS USED IN THE DEVELOPMENT OF THE LITTLE JOE 2-APOLLO TEST VEHICLE AT MACH NUMBERS FROM 0.056 TO 4.65
Robert H. Moore, Jr. Washington May 1968 225 p refs
(NASA-TN-D-4439) CFSTI: HC$3.00/MF$0.65 CSCL 22D

Investigations were conducted to determine the static longitudinal aerodynamic characteristics of several configurations of the Little Joe-Apollo and Little Joe II-Apollo test vehicles at angles of attack from 0° to 90° at the low-subsonic Mach numbers and at angles of attack from −15° to +15° at transonic and supersonic Mach numbers. The tests covered Mach numbers from 0.056 to 4.65. The Little Joe-Apollo configuration was unstable at the subsonic and low-supersonic speeds. Test results indicate that the production-model Little Joe II-Apollo configuration (with trailing-edge control surfaces on the booster fins) is stable throughout the Mach number range tested and that the trailing-edge control surfaces are effective for all Mach numbers tested. This configuration was used in the developmental tests of the Apollo launch escape system. Author

N68-22972*# Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.
C-1 ENGINE: PROPELLANT VALVE QUALIFICATION, VOLUME 2, BOOK 2 Final Report
17 Jul. 1967 228 p refs
(Contract NAS8-15486)
(NASA-CR-61735; RMD-6203-Q2, V. 2, Bk. 2) CFSTI: $3.00 CSCL 22D

Specifications, design concepts, and qualification test directives and procedures for the bipropellant valve used on the C-1 engine are documented. Described are shock test results for the C-1 rocket engine; detailed specifications for the quadredundant valve assembly which define the requirements of a four passage, pulse modulated valve for control of a stabilization and attitude control rocket engine employed for spacecraft; quadredundant valve qualification test procedures; qualification test reports for valve, quadredundant, electrical torque motor operated, pulse modulated Model 50-304; propellant compatibility test data; and valve qualification acceleration test data for one quadredundant valve. S.C.W.

N68-22992*# Battelle Memorial Inst., Columbus, Ohio.
PLANNING RESEARCH IN THE AREA OF LAUNCH VEHICLE AND PROPULSION PROGRAMS Progress Report, 1-31 Mar. 1968
B. W. Davis, A. E. Weller, R. F. Porter, D. S. Edgecombe, and D. A. Nippert 12 Apr. 1968 11 p
(Contract NASw-1146)
(NASA-CR-94397; BMI-NLVP-TPR-68-2; PR-2) CFSTI: HC $3.00/MF$0.65 CSCL 22D

Principal activities in research planning constitute program and report reviews on upper stages and spacecraft which can be expected to reenter the Earth's atmosphere in the 1968-71 time period. Several mathematical studies are reported on orbital transfers and spacecraft propulsion problems. Work on orbital lunar operations and payloads continued with data submissions for some mechanization problems. Included is a breakdown of time and cost estimates. G.G.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N68-21854 Illinois Univ., Urbana.
A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE LATERAL BUCKLING OF AN INTERMITTENTLY STIFFENED I BEAM
Wilbert Wayne Siesennop (Ph.D. Thesis) 1966 88 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-6733

This investigation treats the lateral bucking problem of an intermittently stiffened I beam subjected to laterally built-in ends and a constant bending moment. The I beam is stiffened by spacing plates at intervals along the length of the I beam and attaching these across the outstanding edges of the flanges. Treating each part of the stiffened I beam—the web, two flanges, and several pairs of stiffeners—as flat plates, the strain energy, and likewise, the total potential energy, of the system is calculated. Then employing the Raleigh-Ritz method and stability criteria, the critical bending moment is determined. In the experimental portion, I beams were fabricated by gluing together strips cut from 4×8 foot sheets of masonite 1/8 inches thick; the stiffeners were then glued across the flanges. The critical bending moment was found as the beam was buckled in a Riehle testing machine. The theoretical and experimental solutions are compared. Dissert. Abstr.

N68-21869*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL INVESTIGATION OF THE LONGITUDINAL VIBRATION OF A REPRESENTATIVE LAUNCH VEHICLE WITH SIMULATED PROPELLANTS
James A. Schoenster and Robert R. Clary Washington May 1968 67 p refs
(NASA-TN-D-4502) CFSTI: HC$3.00/MF$0.65 CSCL 22D

The results of an experimental investigation of the longitudinal vibration of a full-scale representative launch-vehicle structure are presented. The vibration characteristics of the vehicle supported upright were determined for frequencies between 5 and 100 hertz by means of force-controlled vibration techniques. Resonant frequencies, resonant response accelerations, and damping values were determined and the degree of nonresonant vibration was investigated. Static deflections of the propellant tanks due to various levels of simulated propellants were also measured. The vibration characteristics of the vehicle were influenced by the simulated propellants. The acceleration data were not always sufficient to identify and to separate the various modes of the vehicle. In these cases, a definition of the effect of the contained liquid on the vehicle structure was required for proper association of the modes. In general, there was good agreement between the resonant frequencies selected for detailed study when one source of excitation, two sources of excitation, or the Kennedy–Pancu method of data interpretation were used. However, data obtained from the two sources of excitation and the Kennedy–Pancu plots indicate significant nonresonant amplitude contributions to the total response amplitude obtained with a single source of excitation. Author

N68-21873*# Southwest Research Inst., San Antonio, Tex.

DYNAMIC STABILITY AND PARAMETRIC RESONANCE IN CYLINDRICAL PROPELLANT TANKS Final Report

Daniel D. Kana, Wen-wha Chu, and Tom D. Dunham 17 Jan. 1968 96 p refs
(Contract NAS8-20329; SwRI Proj. 02-1876)
(NASA-CR-61725) CFSTI: HC$3.00/MF$0.65 CSCL 20K

Dynamic stability and parametric resonance of longitudinally excited cylindrical propellant tanks are investigated to determine the significance of this form of response in launch vehicle systems. A theoretical analysis is conducted to predict the dynamic stability of a simplified model consisting of a partially liquid filled cylinder which has a rigid flat bottom, an internal ullage pressure, and a rigid top mass. Donnell equations for cylindrical shells are used to determine natural frequencies, forced axisymmetric response, and dynamic stability of the model. Numerical results are compared with experimental observations for a range of several significant parameters. Although it is found that the stability is governed by a coupled set of Mathieu–Hill equations, approximate solutions are presented which allow relatively easy determination of stability for the case of principal parametric resonance. Additional experiments are conducted for a 1/16-scale model of a Saturn V LOX tank to determine the influence of ring stiffeners. Instabilities and many forms of nonlinear response are found to be present for tanks having less than three stiffener rings. Author

N68-21912*# Lehigh Univ., Bethlehem, Pa. Dept. of Mechanical Engineering.

PLASTIC ENCLAVE SIZES FOR INTERNAL CRACKS EMANATING FROM CIRCULAR CAVITIES WITHIN ELASTIC PLATES

Thomas Rich Jun. 1967 94 p refs
(Grants NGR-39-007-011; NSF GK-344; NSF GK-1164)
(NASA-CR-94296) CFSTI: HC$3.00/MF$0.65 CSCL 20K

This thesis presents a numerical solution for the estimation of the plastic enclave size at the tip of a crack emanating from an edge or an internal cavity within an elastic plate under various loading conditions. The complex stress function approach of Muskhelishvili in conjunction with conformal mapping techniques is employed to determine the enclave size. To demonstrate this analytical method, the plastic enclave sizes are estimated for single and twin symmetrically located radial cracks emanating from a circular void within an elastic plate under uniform uniaxial tension. The resulting stress intensity data and plastic enclave sizes are presented in tabular and graphical form for a wide range of crack dimensions and tensile loads. From numerical convergence tests on the results, the data is judged to be accurate to within 2%. Author

N68-21980 California Inst. of Tech., Pasadena.

RADIATION OF A POINT CHARGE MOVING UNIFORMLY OVER AN INFINITE ARRAY OF CONDUCTING HALF PLANES

John Ling-yee Lam (Ph.D. Thesis) 1967 126 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-4777

The problem of the excitation of an infinite array of parallel, semi-infinite metallic plates by a uniformly moving point charge is studied by the Wiener–Hopf method. It is treated as a boundary value problem for the potentials of the diffracted electromagnetic fields. A method is used to translate boundary conditions on the fields into boundary conditions on the potentials. In this way the problem is formulated in terms of a set of dual integral equations for the current densities induced on the plates by the point charge. The solutions are found to satisfy the famous edge conditions for diffraction problems, and are therefore unique. From these solutions exact expressions for the diffracted fields are derived in the form of Fourier integrals. The method of steepest descent is then used to obtain expressions for the radiation fields, the Poynting vector, the frequency spectrum and the radiation pattern. The radiation shows that the array of plates behaves both like a diffraction grating and a series of parallel-plate waveguides. Dissert. Abstr.

N68-21988 Netherlands Research Centre TNO for Shipbuilding and Navigation, Delft.

SHIP VIBRATION ANALYSIS BY FINITE ELEMENT TECHNIQUE. PART 1: GENERAL REVIEW AND APPLICATION TO SIMPLE STRUCTURES, STATICALLY LOADED [ANALYSE VAN SHEEPSTRILLINGEN DOOR MIDDEL VAN DE ELEMENTENMETHODE. DEEL 1. ALGEMEEN OVERZICHT EN TOEPASSING OP EENVOUDIGE CONSTRUCTIES, STATISCH BELAST]

S. Hylarides Dec. 1967 31 p refs
(Rept.-107S; TDCK-50068)

For the analysis of the stiffness against deformations ship structures can be divided into elements whose stiffness can be determined with a high degree of accuracy. These elements are connected to each other in nodal points. Expressing the virtual work of the construction in the unknown displacements of these nodal points and differentiating this expression with respect to the displacements, leads to the same number of linear equations for these displacements as the number of the yet unknown displacements. This set of equations represents the stiffness of the construction. The finer the division into elements, the higher the accuracy will be. Dynamical problems can also be solved. For this purpose the masses of the elements are concentrated in the nodal points and so inertia forces are introduced. Determination of the eigenvalues of the set of equations leads to the natural frequencies of the structure. Finally this calculation method is applied to two simple structures statically loaded. The results are compared with an accurate solution. It appears that the reliability of the method is good. Author

N68-22052 Texas Univ., Austin.

UPPER AND LOWER BOUNDS FOR LATERAL VIBRATION FREQUENCIES OF TAPERED BEAMS

J. H. Gaines (Ph.D. Thesis) 1966 154 p
Available from Univ. Microfilms: HC $7.20/MF $3.00 Order No. 67-3281

Two methods for obtaining lower bounds of the natural frequencies of lateral vibrations of beams are employed in conjunction with the Rayleigh–Ritz method to obtain upper and lower bounds for the natural frequencies of vibration of linearly tapered beams with various end conditions. Upper and lower bounds are obtained for the four lowest natural frequencies of truncated wedges and cones having the following end conditions: (1) pinned–pinned, (2) clamped–pinned, (3) clamped–free, and (4) free–free. For these cases the effects of transverse shear and rotatory inertia are not taken into consideration and the values obtained for the upper and lower bounds show very good agreement. The cases of the clamped-free and free–free beams are then analyzed taking into account the effects of shear and rotatory inertia.

Upper and lower bounds for the three lowest frequencies are determined. They show good agreement for the first two modes. For the third, however, the deviation from the mean value is found, in some cases, to be almost twenty percent. Dissert. Abstr.

N68-22054 Florida Univ., Gainesville.

ON DYNAMIC STRESS CONCENTRATION AROUND A DISCONTINUITY

Su Ling Cheng (Ph.D. Thesis) 1966 117 p
Available from Univ. Microfilms: HC $5.80/MF $3.00 Order No. 67-3465

The problem studied was that of the linear, isotropic, homogeneous, elastic, unbounded plate in the state of plane stress. The plate was uninterrupted except for a circular cylindrical discontinuity and was excited by a time-harmonic source of arbitrary intensity. The types of excitation considered were line forces, centers of dilatation and rotation. The discontinuities are rigid inclusions and cavities. The redistribution of dynamic stress due to the presence of the discontinuities was studied and, in particular, the effects of the source location on the concentration of energy on the interface was explored. Dissert. Abstr.

N68-22059 Texas Univ., Austin.

ON PERIODIC SOLUTIONS OF AUTONOMOUS AND NONAUTONOMOUS NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS OF MOTION OF CERTAIN ELASTIC CONTINUA

Charles Everette McQueary (Ph.D. Thesis) 1966 122 p
Available from Univ. Microfilms: HC $6.00/MF $6.00 Order No. 67-3326

A method is developed for obtaining periodic approximate solutions to the equations of motion of certain nonlinear elastic continua. The method is a modification of the Poincaré perturbation method, but is more general in that many problems that cannot be treated by the method of Poincaré are readily treated. Examples studied for both free and forced periodic oscillations correspond to linearly elastic continua attached to a nonlinear elastic foundation. Numerical verification of the proposed method is offered for several of the examples. A method for elimination of small-divisor difficulties, frequently encountered in perturbation solutions, is introduced. New terms introduced are "nonlinear mode," taken to correspond to periodic motion of a nonlinear system, and "modal forcing function," used to describe a forcing function that produces in a nonlinear system a response that is of the same functional form as one of the nonlinear modes for the system. Dissert. Abstr.

N68-22066# General Electric Co., Schenectady, N. Y. Large Steam Turbine-Generator Dept.

REMARKS ON THE TECHNIQUE OF FIELD CONTINUATION IN PLANE ELASTICITY

Hans F. Bueckner 16 May 1967 15 p refs
(TR-67-LS-22)

It is shown how the technique of field continuation can be usefully applied to engineering problems of elasticity. In particular, this report reduces the problems of a rotor with slots, of a half-plane under special constraints and of the semiinfinite strip to either new integral equations or new functional equations of rather simple form. Author

N68-22085 Lehigh Univ., Bethlehem, Pa.

ON SOME PROBLEMS INVOLVING SINGULARITIES IN REISSNER'S THEORY OF PLATE BENDING

Ronald John Hartranft (Ph.D. Thesis) 1966 164 p
Available from Univ. Microfilms: HC $7.60/MF $3.00 Order No. 67-4865

The method of integral transforms is applied to formulate and solve boundary-value problems in the bending of plates. A sixth-order system of differential equations is employed for which all three natural boundary conditions can be satisfied. Considered in detail are problems that involve stress singularities due to load and geometric discontinuities. The intensity of the stresses in the immediate neighborhood of the singularity is governed by a Fredholm integral equation of the second kind. In the cases of a semi-infinite plate bent by a rigid bar bonded to the plate edge and a plate containing a crack, the intensity of the stress singularities changes rapidly as the plate thickness is increased from zero to a finite, but small, value. Certain discontinuities in the solutions were observed when the plate becomes vanishingly thin. A uniqueness theorem for problems with concentrated couples and/or shear forces is also presented. Dissert. Abstr.

N68-22100 Lehigh Univ., Bethlehem, Pa.

THERMAL STRESSES AND ELASTIC-PLASTIC STRESS DISTRIBUTION IN BONDED DISSIMILAR MEDIA WITH CUTS ALONG THE INTERFACE

Earl John Brown (Ph.D. Thesis) 1966 137 p
Available from Univ. Microfilms: HC $6.00/MF $3.00 Order No. 67-4858

The temperature distribution and resulting thermal stress problem for bonded dissimilar media containing straight cracks along the interface are considered by reductions to Hilbert problems. The effect of partial insulation to impede the flow of heat is discussed. Three examples are given and the stresses along the bond are obtained: (1) heat source and sink of finite strength at infinity, (2) uniform heat flow at infinity with central crack in homogeneous materials, and (3) uniform heat flow at infinity with partial insulation of the crack in dissimilar media. The method of solution is extended to cover transient problems for instantaneous line sources of heat. Stress singularities and oscillations are observed near the crack tip. It is found that insulation effects are small compared to the bimaterial effect. Dissert. Abstr.

N68-22134 Stanford Univ., Calif.

CRACK PROPAGATION IN A CONTINUUM MODEL WITH NONLINEAR ATOMIC SEPARATION LAWS

Melvin Fred Kanninen (Ph.D. Thesis) 1966 108 p
Available from Univ. Microfilms: HC $5.40/MF $3.00 Order No. 67-4378

A model for the propagation of a plane crack in an elastic body subjected to a uniform tensile loading normal to the plane containing the crack is developed. The model incorporates the nonlinear atomic force-separation law in representing the rupture of the cohesive forces between the atoms at the crack tip. In the model an atom next to the crack plane experiences a nonlinear force from the atom directly opposite on the other side of the crack plane. All other atomic force-separation relations are taken as given by linear elasticity theory. Consequently, the model is equivalent to a pair of linearly elastic semi-infinite bodies connected everywhere but in a finite interval (the crack) by a dense array of nonlinear springs. Dissert. Abstr.

N68-22140 Virginia Polytechnic Inst., Blacksburg.

THE LARGE DEFLECTION ANALYSIS OF PLATES USING PERTURBATION AND COLLOCATION TECHNIQUES

Joseph David Walter (Ph.D. Thesis) 1967 127 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-6231

Solutions to the equations governing the large-deflection behavior of initially flat thin elastic plates are presented for two classes of problems: "long" rectangular plates under uniform and hydrostatic pressure and a variety of boundary conditions, and doubly symmetric plates under uniform pressure and clamped boundary conditions. In this investigation, deflections are of the order of magnitude of the plate thickness. The coupled nonlinear partial differential equations governing the problem, two of the second order and one of the fourth order, are reduced to a sequence of linear or perturbed equations. For "long" rectangular plates, the perturbed equations, being one-dimensional, are shown to have exact solutions. For plates of finite aspect ratio, the perturbed equations in two dimensions are solved by a newly developed variant of the collocation method, termed the least squares extension of interior collocation. Dissert. Abstr.

N68-22153 Rensselaer Polytechnic Inst., Troy, N. Y.

EXTENSION OF THE HERTZ CONTACT PROBLEM SOLUTION TO A FINITE SIZE OF THE CONTACT AREA

Frederick W. Schmiedeshoff (Ph.D. Thesis) 1966 60 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-4196

The contact problem for a finite contact region is solved for the case of two identical elastic cylinders. The characteristic features of the Hertz contact solution are used in the analysis. The investigation is based upon the formation of a set of successive approximate solutions. A biharmonic stress function satisfying the characteristic Hertz pressure distribution as well as the successive approximations is used in the determination of the shape of the contact region between the cylinders. The degree of accuracy is measured in terms of the deviation from a plane contact boundary which is required when two identical cylinders are in contact. The solution obtained also compares the resultant compressive force required to maintain plane contact for a finite contact arc with that of the Hertz infinitesimal solution. The contact region is determined to be plane within less than .01% and the Hertz resultant force differs from the finite contact solution by less than 1%. Dissert. Abstr.

N68-22192# Royal Aircraft Establishment, Farnborough (England).

CORRELATION OF FATIGUE CRACK PROPAGATION RATES WITH THE STRESS INTENSITY FACTOR IN AN ALUMINUM ALLOY (IDTD 5070A)

D. P. Rooke Sep. 1967 15 p refs
(RAE-TR-67238) CFSTI: HC$3.00/MF$0.65

The results of fatigue crack propagation tests made on the aluminium alloy which were given in a previous report are further analyzed and correlated using improved calculations of the stress intensity factor. Koiter's correction for the plastic flow at the tip of the crack are used. The tests were done on 3 inch panels at three stress levels: 4400±3600 psi, 8800±7200 psi, and 13200±10800 psi; and on 10 inch panels at 4400±3600 psi. The correlation of the results from the 3 inch panels is improved at all stress levels, using the improved stress intensity factor. The correlation between results from 3 inch and 10 inch panels tested at the same stress level was not as good as previously but the differences are not thought to be significant. Author (ESRO)

N68-22218 California Univ., Berkeley.

APPROXIMATE SOLUTIONS IN LINEAR VISCOELASTICITY

Tse-Yung Chang (Ph.D. Thesis) 1966 58 p
Available from Univ. Microfilms: HC $3.00/MF $3.00 Order No. 67-5025

A numerical method of solution for viscoelastic stress analysis is presented. The theory for linear viscoelasticity in the presence of thermal gradients is briefly stated to define the problem under consideration. The formulations for the numerical work are developed by utilizing a finite element idealization for spatial reduction and a finite difference approximation for time integration. Two numerical examples are given. In the first example, a viscoelastic thick wall cylinder encased in an elastic shell is analyzed under isothermal and steady state temperature fields. The second example is a two-dimensional star grain under an isothermal temperature field. Dissert. Abstr.

N68-22237 Pennsylvania State Univ., University Park.

THE SHOCK RESPONSE OF BEAMS WITH NON-LINEAR MATERIAL PROPERTIES

Joseph Jerry Stanovsky (Ph.D. Thesis) 1966 194 p
Available from Univ. Microfilms: HC $8.80/MF $3.00 Order No. 67-5973

Methods for predicting shock response characteristics of purely elastic beams were studied, as were those for the nonlinear beam that was perfectly plastic so that elastic strains were neglected. A cantilever beam, with attached tipmass, was shock loaded by applying a force at the tipmass by an impact hammer. The magnitude and time duration of the loading was such that plastic deformations occurred in the beam. The input force-time variation was measured and used as the force-time input in the theoretical solution. The theoretical method is a numerical solution of the Bernoulli–Euler differential equation of motion. The numerical solution utilizes finite difference equations and, as a result, the solution is approximately correct for a distributed parameter beam, whereas it is a precise solution for a lumped-mass beam system. For the low carbon steel, there was a noticeable time lag between the experimentally measured maximum strain and the analytical value. This may be attributed to a delay-yield time for the material. Dissert. Abstr.

N68-22240 Ohio State Univ., Columbus.

THE APPROXIMATE ANALYSIS OF THIN SHELLS BY THE FINITE ELEMENT METHOD

Cornelis Visser (Ph.D. Thesis) 1966 167 p
Available from Univ. Microfilms: HC $7.80/MF $3.00 Order No. 67-6380

The finite element method, a special form of the Ritz method is extended to thin shells of arbitrary curvature, and a curved triangular shell element is developed through a suitable definition of the boundary surves of the element on the middle surface of the shell. The convergence of the approximate solutions obtained with the above element and displacement functions is shown from the point of view of the Ritz method. The assumed displacement functions are relatively complete, and the proof of convergence is extended to the displacements themselves. The expressions for the stiffness matrix for the triangular curved shell element are derived as well as the corresponding load vector and the consistent mass matrix. The mathematical conditions of relative completeness, applied to the generalized displacement functions of several elements which are used in plane elasticity and plate bending problems, are equivalent to definite physical conditions. Dissert Abstr.

N68-22275*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

METHOD FOR DETERMINING NORMAL MODES AND FREQUENCIES OF A LAUNCH VEHICLE UTILIZING ITS COMPONENT NORMAL MODES

James D. McAleese Washington May 1968 50 p refs
(NASA-TN-D-4550) CFSTI: HC$3.00/MF$0.65 CSCL 22D

The launch vehicle is idealized as a one-dimensional structure consisting of a main beam to which several flexible branches are attached. The normal modes of both the unrestrained main beam and the cantilevered branches are determined. An energy approach is then employed in which the displacement of the vehicle is expressed as the superposition of a finite number of free–free normal modes of the main beam and cantilever normal modes of the branches. Langrange's equations are then used to derive the equations of motion in matrix form, and an iterative method of solution is included for completeness. Author

N68-22297*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.

BASIC RESEARCH ON LIQUID-DROP-IMPACT EROSION

Quarterly Report, 8 Dec. 1966–8 Mar. 1967

Olive G. Engel 8 Mar. 1967 32 p refs
(Contract NASw-1481)
(NASA-CR-84982; QR-2) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A single impact helium driven gas gun capable of accelerating steel spheres to velocities in excess of 1000 ft/sec was designed, constructed and tested. Impact specimens of zinc and Armco iron were prepared and are ready for the room temperature firings. Tantalum specimens are in the final stage of preparation. Specimens for determining the static tensile strength of these metals and specimens for determining the speed of sound both in these metals and in the steel of which the steel spheres were fabricated are also ready for use. In two previous equations for denting velocity, $V_i = 19(zc/z'c')^{1/2}[E'(z+z')/zz']$, where E' is the dynamic compressive yield strength of the target material, c is the velocity of sound in infinite medium, and z is acoustic impedance, and $V_i = k\,[E'(z+z')/zz']$, where k is a numerical constant, there is a factor of difference of $(zc/z'c')^{1/2}$. One-dimensional elastic wave theory relating to the simple case of the impact of two solid rods with flat ends was reviewed to find the significance of this factor. R.N.A.

N68-22299 Lockheed Missiles and Space Co., Palo Alto, Calif.
ANALYSIS OF THE COLLISION OF METAL BODIES ON THE BASIS OF A COMPRESSIBLE FLUID MODEL
A. N. Mar'iamov [1968] 5 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. 1, Mat. i Mekhan. (Moscow), no. 6, 1967 p 109–113

The collision process is separated into three stages; and the second stage, which accounts for material melting behind the shock front in an obstacle, is considered. The two dimensional nature of the collisions and the dependence of the Gruneisen parameter on density are taken into account, and the equation of state of the solids is written on the basis of a Debye model. The case of a metallic striker whose length is considerably greater than its width is considered that meets a semi-infinite obstacle in the direction of the longitudinal axis. During penetration the liquid jet is formed behind the shock in the striker and rotates toward the free surface while acquiring an axisymmetric shape. Flow computations were made by using the mass and momentum conservation theorem; and radii of the contact and free surfaces were determined as a function of the striker radius. Some results are included for the collision of a copper sample with a copper half space and lead sample with a lead half space. M.W.R.

N68-22340*# Little (Arthur D.), Inc., Cambridge, Mass.
PREDICTION OF HEAT TRANSFER IN MULTIPLE GLAZE TRANSPARENCIES Final Report
25 Aug. 1966 97 p refs
(Contract NAS9-4204)
(NASA-CR-92079; C-67248) CFSTI: HC $3.00/MF $0.65 CSCL 11B

This report documents the results of a program to advance the techniques for evaluating the thermal behavior of window systems for space vehicles, particularly those exposed to the environmental conditions attendant to planetary re-entry. The first part outlines the purpose and scope of the program, summarizes its major results, and presents the contributors conclusions and recommendations. The second part describes the theory and mathematical models applied to the solution of the problem of heat transfer in observation window systems typical of those applicable to re-entry type spacecraft. The third part presents the methods and results of tests to examine the validity of the developed computer program to simulate the thermal behavior of spacecraft window systems operating in severe thermal environments. Author

N68-22363# National Bureau of Standards, Washington, D. C. Mechanics Div.
THE HYPERBOLIC CHARACTER OF CERTAIN EXPERIMENTAL RESULTS WHICH TEND TOWARD LIMITING VALUES
Arthur F. Kirstein Nov. 1967 13 p refs
(NBS-TN-435) GPO: $0.15

The hyperbolic character of certain experimental data obtained from structural and mechanical testing provides an extremely simple graphical method for use in approximating the limiting values associated with the data. The method, developed by Southwell to explain the behavior of eccentrically loaded thin elastic struts, is shown to have much wider application. A limited number of illustrations are given to describe the method and to show how it might be used as a research tool. Author

N68-22384*# Denver Univ., Colo. Research Inst.
MATRIX METHODS AND AUTOMATION IN STRUCTURAL ENGINEERING
Anita West and William F. Hubka [1966] 21 p refs
(Grant NsG-518)
(NASA-CR-71230) CFSTI: HC $3.00/MF $0.65 CSCL 13M

A comprehensive survey of available computer programs was performed for large matrix inversion and for eigenvalue and eigenvector solutions and the techniques are developed in this paper for using these programs most efficiently for structural applications. The contents of the paper include: automation of matrix compilation, methods of vary large matrix inversion and solution of simultaneous equation, and techniques for finding eigenvalues and vectors. In addition, a finite element stiffness matrix approach developed for both plates and shells subject to arbitrary dynamic loads is described as it was instrumented with complete automation on the digital computer. Author

N68-22390# General Electric Co., Philadelphia, Pa. Missile and Space Div.
ON SOME EXTREMUM PRINCIPLES IN LINEAR ELASTODYNAMICS Technical Information Series
M. Ben-Amoz Jun. 1967 15 p refs
(Doc.-67SD277)

Extremum principles are established for linear anisotropic elastodynamics in terms of polarization tensors. The principles provide upper and lower bounds on the action integral and are thus suitable for the derivation of bounds on effective elastic moduli and wave velocities in heterogeneous materials. It is shown that when certain constraints are removed the present principles reduce to previous polarization principles given by the author. Author

N68-22408 Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON SOME PROPERTIES OF THE STRESS STATE OF A THIN ELASTIC LAYER
M. I. Gusein-Zade 1967 13 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 31, no. 6, 1967 p 1132–1140

The internal stress state of a thin elastic layer was investigated by the asymptotic integration of Lame equations, assuming that displacements in the plane of the layer were less than those out of its plane. Differential equations of the internal stress state are evolved, as are means of satisfying the boundary conditions. A sandwich plate is considered, for which six geometric and six static conditions must be satisfied on the contact planes between the filler and the carrying layers. Eliminating the arbitrary functions from the 12 interlinkage conditions for the layers in the zero approximation results in six coupling conditions in the zero approximation and a solution to the problem. M.W.R.

N68-22417 Lockheed Missiles and Space Co., Palo Alto, Calif.
FREE VIBRATIONS OF SHALLOW CYLINDRICAL SHELLS

A. D. Lizarev and L. D. Pavlovskaia 25 Aug. 1966 9 p refs Transl. into ENGLISH from Prikl Mekh., Akad. Nauk Ukr. RSR (Kiev), v. 4, no. 1, 1968 p 54–61

Free vibrations of shallow circular cylindrical shells are investigated by an exact method. Symmetric and skew-symmetric vibrations modes of shells with symmetric elastic fixing along straight line edges and hinge support at the endplate diaphragms are examined. Frequency equations are derived which have a different form depending on whether the roots of the characteristic equations are real, imaginary, complex conjugate or multiple. Numerical results on the determination of the vibrations frequencies and modes are obtained. The influence of the geometry of very shallow shells on some peculiarities of their vibrations is discussed.
Author

N68-22432# General Electric Co., Philadelphia, Pa. Missile and Space Div.

A CONTINUUM APPROACH TO THE THEORY OF ELASTIC WAVES IN HETEROGENEOUS MATERIALS Technical Information Series

M. Ben-Amoz Jun. 1967 15 p refs
(Doc.-67SD276)

The neighborhood concept is utilized to substitute for a given heterogeneous medium a simpler medium endowed with dispersion characteristics. The connection of displacement fields in the two media through neighborhood influence coefficients leads directly to an affine connection and wave velocity coefficients needed for the complete characterization of the new medium. The torsion part of the connection is interpreted in terms of a curvature deviation tensor analogous to the lattice curvature tensor. Conjugate fields of stress and momentum are defined for the new medium in a manner leading to separation of the total wave problem into two distinct phases. In the first, only average fields are sought through appropriate equations of motion derived herein. In the second, local stress deviation fields appear related to average stress in a manner similar to that encountered in theories of thin shells.
Author

N68-22525 Lockheed Missiles and Space Co., Palo Alto, Calif.

SNAPPING OF A CYLINDRICAL PANEL SUBJECTED TO AN ACOUSTIC PRESSURE SHOCKWAVE

E. I. Grigoliuk, A. G. Gorshkov, and F. N. Shkliarchuk [1968] 8 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), no. 5, 1967 p 50–55

Approximations for the shape of the moving panel and of the pressure from the acoustic wave field are taken into account in an analytical solution of the nonlinear motion and snapping of an elastic cylindrical panel subjected to weak acoustic pressure shock waves. The Bubnov–Galerkin method was used to determine pressure of both reflected and radiated waves, with the pressure of waves reflected from absolutely rigid shells yielding the greatest contribution to the total pressure on the shell. The solution begins with the Marguerre nonlinear equations of shallow shell theory, and an approximation is made of the deflection and stress in the middle surface of the shallow shell. Hydrodynamic pressure on the shell surface is considered, and a solution is given for shock interaction with a cylindrical shell. To consider snapping in water comparatively large interaction time intervals with shock must be considered; and the asymptotic functions may not present good results for impact in water where radiation pressure plays an essential role. Since radiation pressure can be neglected in air, the asymptotic expression can be used.
M.W.R.

N68-22526 Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON THE ANALYSIS OF LINE LOADED CYLINDRICAL SHELLS

E. I. Grigoliuk and V. M. Tolkachev 1967 9 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 31, no. 6, 1967 p 1141–1146

A Green function is used to compute the concentrated force on a closed circular cylindrical shell that is loaded along an arbitrary line of its middle surface. The integral constructed corresponds to the solution for an infinite shell, and boundary conditions on the endfaces of the shell may be satisfied by solving homogeneous equations for a shell slit along the loading line. Means of calculating the stress state of cylindrical shells reinforced by longerons or ribs that take on the external forces are also considered.
M.W.R.

N68-22533# General Electric Co., Philadelphia, Pa. Missile and Space Div.

EFFECT OF IN-PLANE TENSILE LOADS ON TRANSVERSE BENDING OF BEAMS Technical Information Series

Arthur L. Ross 30 Jun. 1967 22 p refs
(Doc.-67SD264)

The beam element lateral rigidity matrix, including the effect of tensile preload upon the rigidity, is derived and compared with more approximate values already available in the literature. It is shown that for tensile loads larger than the compressive buckling load of the beam element, the previously published rigidity matrixes are in considerable error. This might be expected since the primary application of the previously published results were for compressive buckling. The exact matrix coefficients (neglecting shear flexibility) are derived along with two simpler approximations which are valid for high tensile loads. The previously published rigidity matrices assumed that the deflection shapes were uneffected by the axial load, i.e. a "quasi-uncoupled solution." The rigidity matrix presented in this document does not make this simplifying assumption. Common sources of tensile preload are those arising from thermal contraction and mechanical pretensioning (violin string effect). An important effect of tensile preload is its increase of the natural bending frequency of beams.
Author

N68-22539# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

NONDESTRUCTIVE TESTING OF ISOTOPE CONTAINMENT CAPSULES: PHASE 1, SNAP-21, AND SNAP-23

R. W. Steffens, H. N. Pedersen, and F. M. Coffman Jan. 1968 28 p
(Contract AT(45-1)-1830)
(BNWL-528) CFSTI: HC$3.00/MF$0.65

Because of the toxic and radioactive nature of the core material contained in isotope heat sources, the integrity of the container must be assured through a reliable quality control program. This program must include measurements capable of providing both quality assurance of the product and information feedback for process control. In the case of isotope containment capsules, standard radiographic techniques are not capable of detecting the small volume cracks typically found in the closure welds. To solve the quality control problem, an ultrasonic test system has been devised to provide accurate and reliable measurements of the container closure weld parameters. Specifically, tests have been devised to measure the depth of weld penetration, to detect cracks in the weld volume, and to detect excessive meltdown of the outer weld corner. The ultrasonic techniques developed for the evaluation of weld quality on the three-pass, peripheral end-cap weld on SNAP-21 and SNAP-23 isotope containment capsules are described, verification of the ultrasonic measurements using the results of extensive metallographic analysis is discussed, and the three-pass weld technique evaluated.
Author (NSA)

N68-22578 Lockheed Missiles and Space Co., Palo Alto, Calif.

STATIONARY MOTION OF AN ELASTIC CONTOUR IN A BOUNDED FLUID

B. S. Berkovskii 2 Mar. 1967 6 p refs Transl. into ENGLISH from Prikl. Mekh., Akad. Nauk Ukr. RSR (Kiev), v. 3, no. 11, 1967 p 114–119

A static aeroelasticity problem is considered. The carrying capacity of a thin elastic contour in an ideal bounded and unbounded fluid is investigated. An aero-hydroelastic regular integral operator is constructed to supplement the equation of a thin stiff contour under the assumptions of linear theory. The obtained equation (1.4) is solved approximately. The first variational approximation describes the change in lift of the contour under the influence of elasticity in both an unbounded flow, and also near a screen or under a free surface. Specific cases are considered. Besides the traditional problems of passive mechanization, the mentioned direction includes an extensive circle of questions on elastically and inelastically deformable lifting surfaces in bounded and unbounded fluids. Author

N68-22620# Bettis Atomic Power Lab., Pittsburgh, Pa.
SOME NUMERICAL TESTS OF ELASTICITY SYNTHESIS
J. B. Yasinsky Oct. 1967 11 p refs
(Contract AT(11-0)-GEN-14)
(WAPD-TM-737) CFSTI: HC$3.00/MF$0.65

The synthesis approximation, well known in the reactor theory field, has been applied to the problem of obtaining plane-strain material displacements induced by thermal gradients in two specific problems. A technique for choosing trial functions is presented which resulted in reasonable approximate synthesis solutions. The synthesized displacements are compared pointwise with two-dimensional finite difference solutions of the problems considered. Author (NSA)

N68-22702# Australian Aeronautical Research Committee, Melbourne. Dept. of Supply.
SOME THOUGHTS ON CUMULATIVE FATIGUE DAMAGE THEORY
F. H. Hooke Apr. 1967 25 p refs
(ARL/SM-315) CFSTI: HC$3.00/MF$0.65

The concept of fatigue damage is examined with particular reference to the problem of accumulating damage from load cycles of different amplitude. A damage parameter is defined, which represents the state of a fatigued component at a particular stage, and a damage capacity which specifies its tolerance to fatigue cycling. The damage capacity distribution of a set of identical components may be defined in several different ways, one of which is in terms of life distribution. Some non-interactive damage accumulation rules are examined, including the simple Miner rule, a generalised Miner rule, and a generalised form of a concept due to Bastenaire, by which the resulting life distributions may be established. It is shown that the simple Miner rule requires constancy of distribution shape at all stress levels—a condition frequently not fulfilled in practice. In several varieties of step and program test, life distributions are predicted and compared with experiment. The predictions are satisfactory for program but not for step tests. Author

N68-22806# Catholic Univ. of America, Washington, D. C.
AN EXPERIMENTAL VERIFICATION OF LIMIT ANALYSIS OF SHORT CYLINDRICAL SHELLS
Nicholas Perrone Oct. 1967 10 p refs
(Grant NSF GK-782)
(Rept.-4; AD-664202)

The purpose of the note is to present some novel experimental results which essentially verify short shell theory wherein bending predominates. TAB

N68-22808* National Aeronautics and Space Administration, Washington, D. C.
DETERMINATION OF THE NATURAL OSCILLATING FREQUENCIES OF SHELLS OF COMPLEX SHAPE WITH FREE EDGES [K VOPROSU OB OPREDELENII SOBSTVENNYKH CHASTOT KOLEBANIY OBOLOCHEK SLOZHNYKH FORM SO SVOBODNYMI KRAYAMI]
G. M. Sal'nikov and A. G. Zenukov May 1968 9 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekhn. (Kazan), v. 10, no. 4, 1967 p 143–148
(NASA-TT-F-11719) CFSTI: $3.00 CSCL 20K

An experimental investigation is made of circular and noncircular conical and cylindrical shells, shells in the form of hollow, internally braced turbine blades, and solid conical shells with partly circular and partly cylindrical cross sections. The influence of the amplitude and type of excitation (impact of a rubber hammer, acoustic excitation by radio loudspeaker, and excitation by means of an electromagnetic vibrator) on the natural frequency is studied. Using the concept of a fictitious radius R_f, an empirical formula is derived which yields, with engineering accuracy, the natural frequencies of the class of shells under consideration. Author

N68-22822# Aeronautical Research Council (Gt. Brit.).
RANDOM AND SYSTEMATIC FACTORS IN THE SCATTER OF CREEP DATA
K. F. A. Walles 1967 82 p refs Supersedes NGTE-NT-601; ARC-28326
(ARC-CP-935; NGTE-NT-601; ARC-28326) CFSTI: HC$3.00/MF $0.65

The study of scatter in creep is facilitated by using a previously developed formula to provide mean values of creep properties. Scatter can then be determined not only from the relatively few sets of tests repeated under identical conditions, but also from the far more numerous sets of tests performed under different conditions. Earlier studies suggested that scatter was, to a first approximation, distributed according to the Gaussian normal error form. In the present study, it has been found that the distributions are often multimodal, and can be resolved into two or more component distributions each of which is Gaussian. Multimodal distributions show regularities in that, for a given composition, the standard deviation in temperature and the mean spacing in temperature between components is the same in each component distribution and in each cast. The present study of Nimonics 80, 80A and 90, and of 18-12-Nb alloy supports the previous agreement of the formula with experimental data in finer detail and further validates the formula as a means of extrapolation. Author

N68-22919*# Texas A&M Univ., College Station.
NONLINEAR ANALYSIS OF SHELLS OF REVOLUTION BY THE MATRIX DISPLACEMENT METHOD
James A. Stricklin, Walter E. Haisler, Hugh R. MacDougall (Sandia Corp., Albuquerque, N. Mex.), and Frederick J. Stebbins (NASA. Manned Spacecraft Center, Houston, Tex.) Aug. 1967 11 p refs Presented at AIAA 6th Aerospace Sci. Meeting, New York Prepared for Sandia Corp., Albuquerque, N. Mex.
(Grant NGR-44-001-044; Contract AT(29-1)-789)
(NASA-CR-94510; SC-DC-67-2054; CONF-680101-2) CFSTI: HC$3.00/MF$0.65 CSCL 20K

A method is presented for the nonlinear (large deflection) analysis of shells of revolution with both symmetrical and asymmetrical loadings. The efficiency and accuracy of the resulting numerical program make it of practical as well as theoretical value. Author (NSA)

N68-22984*# Wayne State Univ., Detroit, Mich.
ON A NONLINEAR THEORY OF ELASTIC SHELLS
H. Cohen and C. N. de Silva (Manitoba Univ.) [1966] 13 p refs
(Grant NGR-23-006-047)
(NASA-CR-94408) CFSTI: HC$3.00/MF$0.65 CSCL 20K

The present paper develops a general nonlinear theory of elastic shells for which the strain measures depend on first and second order deformation gradients. The reduction to theories of previous work is indicated. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N68-21858*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
FLOW FIELD COMPUTATIONS FOR BLUNT BODIES IN PLANETARY ENVIRONMENTS (EQUILIBRIUM) Final Report
C. J. Studerus, C. L. Kyriss, H. Rie, and C. V. Dohner 28 Aug. 1967 164 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951647)
(NASA-CR-94239; Doc.-67SD358) CFSTI: HC $3.00/MF $0.65 CSCL 20M

This study presents the variation of shock layer state and motion variables, and the resulting variation of radiative and convective heat transfer, about two blunt bodies traveling hypersonically at zero angle of attack in an assumed Martian atmosphere whose composition (by volume) is 70% N_2 and 30% CO_2. The body configurations are spherically-blunted 60-degree sphere-cone with spherically-rounded shoulders and a sphere-cap with sharp shoulders. The two free stream conditions for which calculations are made correspond to those encountered in a typical hyperbolic Martian entry trajectory at the point where maximum stagnation point radiative heat transfer might be expected, and to the flow conditions in a ballistic range facility which has been used to simulate the stagnation point heating environment expected for the hyperbolic entry condition. The computations of the shock layer flows were made on the basis of a separate non-radiating equilibrium viscous boundary layer analysis, together with a calculation of radiation from this combined inviscid–viscous shock layer. The effect of self-absorption of the flow field is accounted for in the radiation calculations, and the effect of the radiation on the convective heating is evaluated. Author

N68-21878 Lehigh Univ., Bethlehem, Pa.
QUANTUM CORRECTIONS TO THE VISCOSITY AND THERMAL CONDUCTIVITY OF A MODERATELY DENSE GAS
Paul Theodore Herman (Ph.D. Thesis) 1966 189 p
Available from Univ. Microfilms: HC $8.60/MF $3.00 Order No. 67-4867

Starting from the correlation function expressions for the transport coefficients, we first develop general expressions which will allow the evaluation of the density corrections for any short-range repulsive intermolecular potential. These expressions include quantum corrections which have not been heretofore considered; the quantum corrections are a consequence of the same quantum-mechanical diffraction effects which give rise to quantum corrections to the scattering cross section. We then specialize to the case of a hard-sphere intermolecular interaction. Using the formalism developed earlier, we evaluate expressions for the viscosity and thermal conductivity of a nondegenerate moderately dense gas of hard-sphere bosons; we find new quantum corrections to the classical Enskog collisional transfer corrections. We also show that in the classical limit our expressions reduce to the well-known classical Enskog expressions for the viscosity and thermal conductivity of a hard-sphere gas. Dissert. Abstr.

N68-21894*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE STATISTICAL THEORY OF THERMAL CONVECTION AT LARGE PRANDTL NUMBER
J. R. Herring Apr. 1968 77 p refs
(NASA-TM-X-63171; X-641-68-141) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Three statistical theories of turbulence are applied to thermal convection between infinite slippery plates in the limit of infinite Prandtl number. The range of Rayleigh number R investigated is $657 \leq R \leq 1.25 \times 10^4$. The theories, which are compared in a series of numerical calculations, are the direct interaction approximation, the quasi-linear approximation, and the quasi-normal approximation. The direct interaction approximation gives results for the evolution Nusselt number in good agreement with some simple exact solutions to the problem. The flow predicted by this method is very presistent. Turbulence first appears just at critical R and its intensity gradually increases with increasing R. The quasi-normal approximation gives satisfactory results for $R \leq 2000$, but some of the initial value problems lead to an unphysical negative temperature autocorrelation spectrum for larger R. In none of the initial value problems for $R > 2 \times 10^3$ did the quasi-normal procedure yield a sensible stationary state. The quasi-linear approximation appears to upperbound the heat transport given by both the other approximations predicting about 10% larger heat transport than the direct interaction approximations. Author

N68-21915*# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
EXPERIMENTAL INVESTIGATIONS OF LIQUID PROPELLANT COMBUSTION PROCESSES USING STREAK PHOTOGRAPHY
Richard M. Williams, Jr. Feb. 1968 62 p refs
(Contract NASr-217)
(NASA-CR-72371; AMS-TR-800) CFSTI: HC $3.00/MF $0.65 CSCL 21B

Measurements of droplet breakup wave frequency were taken under a variety of experimental conditions. These included measurements with 90° impinging jet injectors of several orifice diameters, pressure drops up to 150 psi, and involved several fluids. The data resulting from streak photographs were empirically correlated to give a relationship between frequency, chamber pressure, and other pertinent parameters. Application of the empirical relationship to actual rocket motor data with intermediate frequency range pressure oscillations resulted in a linear data fit, thereby supplying some support to the association of impinging jet breakup and intermediate frequency combustion pressure oscillations. Unsteady combustion was studied with both streak photography and pressure transducers. The resulting velocity and pressure data at various axial locations together with other results tended to confirm that the research motor was quite similar to the one dimensional model. Author

N68-21994* Techtran Corp., Glen Burnie, Md.
THERMAL IGNITION REGIME IN A COUETTE FLOW [TEPLOVOY REZHIM ZAZHIGANIYA V POTOKE KUETTA]
Sh. A. Yershin and R. P. Rybalova Washington NASA Apr. 1968 15 p refs Transl. into ENGLISH from the publ. "Teoriya i Praktika Szhiganiya Gaza" Leningrad, Nedra Press, 1967 p 234–245
(Contract NASw-1695)
(NASA-TT-F-11662) CFSTI: $3.00 CSCL 21B

The conditions of ignition in a Couette flow are analyzed considering the hydrodynamics of the flow. The problem is reduced to finding a set of values of all parameters (u_0, T, q, etc.) of the flow being analyzed for which an infinitely small perturbation of any parameter causes a sharp, critical transition from the slow reaction to a rapid, unstable burning of the mixture. Depending on the value of u_0 and the rate of the chemical reaction, the temperature distribution in the gas may vary. Three cases of heat transfer are possible: conductive heat transfer from the warmer wall through the flow to the cooler wall; all heat is transferred through the cold wall, or the maximum temperature established in the flow is greater than the temperature of either wall, and the heat leaves the system through both walls. Author

N68-22058# Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique.

MASS TRANSFER ON A CYLINDRICAL–CONICAL OBSTACLE [TRANSFERT DE MASSE SUR UN OBSTACLE CYLINDRO–CONIQUE]

Gia Ben Diep Dec. 1967 26 p refs In FRENCH
(Rept.-67-8) CFSTI: $3.00

Tests were made in the same wind tunnels that previous measurements had been made on the mass transfer on circular cylinders to see if analogous phenomena existed for conical objects. While the measures were not made with the same degree of accuracy in the supersonic regime; at weak speeds, however, the effect of the incidence on the cone as well as turbulence were in agreement with those previously obtained for cylindrical objects. In the case of a cone at null incidence, values obtained for Sherwood numbers were close to those calculated by the Mangler transformation, assuming the pressure gradient to be negligible. Longitudinal turbulence similar to that for cylinders at oblique angle of attack was found in the boundary layer of cylindro-cones at incidence. The presence of turbulence in the free flow assists the mass transfer on the cone at incidence; although at null incidence, turbulence has practically no effect. These conclusions are based on observations of a two dimensional boundary layer for which the turbulence does not modify the heat transfer as long as there is a pressure gradient. Transl. by M.W.R.

N68-22083 California Univ., Berkeley.

CONVECTIVE TRANSFER PROCESSES IN LAMINAR GAS-LIQUID CHANNEL FLOW

Charles Harry Byers (Ph.D. Thesis) 1966 269 p
Available from Univ. Microfilms: HC $12.15/MF $3.50 Order No. 67-5014

Interphase mass transfer has been studied experimentally and theoretically for cases where resistance to mass transfer is confined to the gas phase and where control is distributed between phases. A numerical solution was performed of the laminar transport equation for a parabolic velocity profile with a cocurrently moving boundary. Experiments in which pure ethanol was evaporated into two gases, CO_2 and oxygen, showed agreement with this theory within the estimated experimental error of 10%. Numerical solutions were performed of two cases of interphase mass transfer. The first is for parabolic velocity profiles in both phases, and the second assumes a parabolic profile in the gas and a constant velocity in the liquid. Experiments were carried out in which ether was evaporated from dilute ethanol solutions into two gases, CO_2 and helium, in cocurrent flow. A series of cocurrent interphase experiments was made, using water as the solvent. Dissert. Abstr.

N68-22086 Michigan Univ., Ann Arbor.

ON THE INSTABILITY OF A THERMALLY STRATIFIED FLOW

Chi Yuan (Ph.D. Thesis) 1966 72 p
Available from Univ. Microfilms: HC $4.00/MF $3.00 Order No. 67-1827

The purpose of this thesis is to investigate the effect of a continuous stratification on the stability of a viscous flow between two parallel inclined plates at the nondiffusive limit. A thermally stratified flow with antisymmetric velocity distribution in the primary flow is chosen. The perturbation of the stream function and of the temperature are expanded in a power series of the wave number. When the fluid is considered nondiffusive, the order of the governing differential equation is reduced from six to four, therby creating artificial singularities. Whenever those singularities are outside of the physical domain, Chandrasekhar's method is used to determine the fundamental mode in the zeroth approximation and the critical Reynolds number in the first approximation. When the singularities lie inside the physical domain, the governing differential equation is solved by power series. The solution involves logarithmic singularities. Dissert. Abstr.

N68-22095*# Pratt and Whitney Aircraft, West Palm Beach. Research and Development Center.

COMPUTER SIMULATION OF HIGH FREQUENCY COMBUSTION INSTABILITY AND ITS SUPPRESSION Final Report

R. E. Bucher 30 Apr. 1968 158 p refs
(Contract NASw-1512)
(NASA-CR-94304; PWA-FR-2634) CFSTI: $3.00 CSCL 21B

A digital computer program was prepared for the simulation of gas motion driven by combustion energy within a slab rocket motor. The computer program is based on numerically integrating the laws of inviscid fluid dynamics by a two-step Lax–Wendroff technique. Provisions were made in the program for a sound-absorbing liner at the wall of the chamber to simulate the absorption of acoustic waves. The program was employed to illustrate the effects of some of the variables on combustion instability and its suppression. Author

N68-22118*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECTS OF SHOCK IMPINGEMENT AND OTHER FACTORS ON LEADING-EDGE HEAT TRANSFER

Dennis M. Bushnell Washington Apr. 1968 17 p refs
Presented at the Conf. on Hypersonic Aircraft Technol., Moffett Field, Calif., 16–18 May 1967 Submitted for publication
(NASA-TN-D-4543; NASA-SP-148) CFSTI: HC $3.00/MF $0.65 CSCL 20M

An investigation was conducted at a Mach number of 8 to determine the effects on stagnation-line heat transfer of shock impingement, chordwise grooves in the leading edge, and end contamination of the leading-edge boundary layer from an adjoining surface. Heat-transfer measurements were made along the leading edge of a 76° swept fin mounted on a flat plate. Tests were made with and without a series of small chordwise grooves cut into the leading edge to simulate construction details. Analysis of the observed heating distribution on the leading edge with the grooves indicates that some fraction of the stagnation-line boundary layer is bled off by the grooves, so that a new viscous sublayer grows downstream of each groove. The general level of heating was about the same as or less than the leading-edge heating data obtained on the same configurations without the grooves. Author

N68-22156# Aeronautical Research Council (Gt. Brit.)

HEAT TRANSFER CALCULATIONS FOR THE CONSTANT PROPERTY TURBULENT BOUNDARY LAYER AND COMPARISONS WITH EXPERIMENT

F. A. Dvorak (Cambridge Univ.) and M. R. Head (Cambridge Univ.) 5 Dec. 1967 36 p refs
(ARC-29716) CFSTI: HC $3.00/MF $0.65

A method of calculation proposed earlier depended upon the numerical integration of the heat transfer equation within fields of velocity and conductivity defined by an approximate solution of the boundary layer equations. In the present paper, some improvements are made to the original calculations and comparisons with experiment are given. The conclusion is reached that, where there are large streamwise variations in surface temperature only methods essentially similar to the present one are capable of giving acceptably accurate results. Author (ESRO)

N68-22171 Michigan Univ., Ann Arbor.

INFRARED SPECTROSCOPIC STUDY OF HYDROGEN FLUORINE FLAMES

Frederick Scott Simmons (Ph.D. Thesis) 1966 126 p
Available from Univ. Microfilms: HC $6.20/MF $3.00 Order No. 67-1604

The analytical part of this study is an extension of the Ladenburg–Reiche analysis of the growth of isolated Lorentzian lines to the nonisothermal case for which neither a "weak-line" nor a "strong-line" approximation is appropriate. The experimental part of this study consisted of quantitative measurements of absorption and emission in H_2-F_2 flames in order to provide more reliable data on the high-temperature spectral properties of HF with which the theoretical calculations could be checked. A flame model involving an assumption of related distributions of temperature and HF concentration in the mixing region was used to provide values of the spectral and spatial distributions in apparent temperature based on theoretical line strengths and the nearly-weak or nearly-strong line approximations as appropriate. The overall agreement between theory and experiment was satisfactory: the adiabatic flame temperature for the stoichiometric H_2–F_2 flame was determined to be 4220±50°K. Dissert. Abstr.

N68-22195*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

HEAT CONDUCTIVITY OF GRANULAR SYSTEMS

G. N. Dul'niev and Z. V. Sigalova 29 Feb. 1968 22 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 7, no. 10, 1964 p 49–55 Prepared in cooperation with Redstone Sci. Information Center
(NASA-TM-X-61060; RSIC-755) CFSTI: HC $3.00/MF $0.65 CSCL 20M

An analytical description of heat transfer in a model of a granular system is given. New expressions are derived for heat conductivity of granular systems with filling gas under normal and under various pressures. Author

N68-22229*# General Electric Co., Philadelphia, Pa. Space Sciences Lab.

HYPERVELOCITY HEAT TRANSFER STUDIES IN SIMULATED PLANETARY ATMOSPHERES, APPENDIX Final Report

Jun. 1967 144 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950297)
(NASA-CR-94316) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Various gas dynamic properties associated with travelling and stationary shock fronts in a shock tube are depicted for three gas mixtures; 3% CO_2–97% N_2, 9% CO_2–90% N_2–1% A, and 25% CO_2–74% N_2–1% A. The thermochemical equilibrium calculations for different gas mixtures were extended up to temperatures of 17,000°K, and three basic equations relating the state of the gas on both sides of a normal shock are given. Chemical equilibrium properties and specie particle density associated with the incident, standing reflected normal shock waves in shock tube were calculated for gas mixtures; 60% CO_2–40% N_2, 9% CO_2–61% N_2–30% A, and 60% CO_2–10% N_2–30% A. Figures for these different gas mixtures are given to show flow properties behind incident shock wave, standing shock flow properties, stagnation enthalpy, and reflected shock properties. B.S.D.

N68-22230*# General Electric Co., Philadelphia, Pa. Space Sciences Lab.

HYPERVELOCITY HEAT TRANSFER STUDIES IN SIMULATED PLANETARY ATMOSPHERES Final Report

Mar. 1968 245 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950297)
(NASA-CR-94317) CFSTI: HC $3.00/MF $0.65 CSCL 20M

An investigation was conducted on the radiative and convective heat transfer on a vehicle entering a planetary atmosphere. Using an electrically driven shock tube to generate the desired aerothermodynamic conditions, measurements of convective heat transfer to the stagnation point of a blunt model were conducted in two gas mixtures representing postulated atmospheres of Mars and Venus. The techniques and instruments for conducting the experiments are described. Measurements of equilibrium and nonequilibrium radiation are assessed, and a comparison of incident shock and standing shock intensity measurements is presented. The total radiation measurements in several planetary atmospheres were considered, and the measurement of vacuum UV radiation in simulated planetary atmospheres is discussed. Effects of self-absorption in the shock layers were studied in 25% CO_2–75% N_2 atmosphere using splitter plates immersed in the flow behind the incident shock wave. The flight velocity simulation extended up to 45,000 ft/sec which encloses the envelope of possible entry velocities presently contemplated. B.S.D.

N68-22265 Lockheed Missiles and Space Co., Palo Alto, Calif.

EQUILIBRIUM THERMAL FLUCTUATIONS IN CONTINUOUS DISSIPATIVE SYSTEMS

S. M. Rytov [1968] 15 p refs Transl. into ENGLISH from a Russian book

Two applications are given for the formulas of the fluctuation–dissipation theorem on a discrete dissipative system in which the equilibrium thermal fluctuations are described by a set of some finite number generalized coordinates. The theorem is extended to distributed continuous systems in which the fluctuations are described by random fields (functions of the time and points of space) rather than by random functions of time. It is shown how such an extension permits application of the theorem to the Maxwell equations, the equations of hydrodynamics, and the elasticity theory. Thermal fluctuations in electrodynamics are considered, and Maxwell equations to which it is suitable to apply the fluctuation–dissipation theorem are derived. M.G.J.

N68-22318*# Tennessee Univ., Tullahoma. Space Inst.

RADIATION HEAT TRANSFER IN ABSORBING, SCATTERING, AND EMITTING MEDIUM

F. Shakrokhi and P. Wolf Washington NASA Apr. 1968 22 p refs
(Grant NGR-43-001-021)
(NASA-CR-1023) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Radiative heat flow is computed between plane parallel, plates with anisotropically scattering atmosphere. Results indicate that a usable solution to the problem can be obtained by simple iteration of the set of equations which result from approximation of the equation of radiation transfer. The iteration worked perfectly, the computer program is simple and short, and the method can accomodate the same, if not more, parameter variations than more analytical treatments. Author

N68-22382 Lockheed Missiles and Space Co., Sunnyvale, Calif.

MACROSCOPIC COEFFICIENTS OF HEAT CONDUCTION AND DIFFUSION IN MICRO-INHOMOGENEOUS SOLIDS

V. V. Bolotin and V. N. Moskalenko 1967 8 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 6, 1967 p 7–13

A method is given for evaluation of the macroscopic coefficients of heat conduction for micro-inhomogeneous solids, whose local coefficients of heat conduction form an ergodic homogeneous random field. In the case of a strong isotropy of the field of local coefficients the calculations are complete. The final formulas are no more complicated in structure than the corresponding first-approximation formulas. Results are presented of calculations for some other cases. The influence of anisotropy of the crystallites on the coefficient of heat conduction of a polycrystalline material is discussed. Author

N68-22397 Lockheed Missiles and Space Co., Palo Alto, Calif.

DIFFERENTIAL EQUATIONS TO INVESTIGATE RADIANT HEAT EXCHANGE IN ABSORBING-RADIATING MEDIA

A. D. Rekin [1968] 7 p refs Transl. into ENGLISH from Inzh. Fiz. Zh., Akad. Nauk Belorussk. SSR (Minsk), v. 13, no. 4, 1967 p 489–495

New differential equations are considered for studying heat transfer in a flat, absorbing bed with increased accuracy. It is found that solutions to equations can be obtained by successive approximations with the use of constant values for auxiliary functions in the first approximation. The results of the second approximation are shown to be in good agreement with those of the accurate solution in case of a constant radiant flux. Author

N68-22415*# TRW Systems, Redondo Beach, Calif.

EMITTANCE OF ABLATIVE MATERIALS Final Report

B. E. Newman [1967] 63 p refs
(Contract NAS9-4518)
(NASA-CR-62063) CFSTI: HC$3.00/MF$0.65 CSCL 20M

Emittance as a function of temperature was determined for five rocket engine liner ablative materials: Irish Refrasil (WBC 2234), Fiberite MX 2600, Fiberite MX 2646, Refrasil cloth/phenolic resin (U.S. polymeric XR 2015), and magnesium hydroxide (WBC 5217). Both laboratory-prepared specimens and those taken from fired ablative liners were used. The emittance of the former was rather constant at temperatures between 25 and 1120°C, while there was a general decrease for the engine specimens. It appears that only approximate comparisons can be made between the two types of specimens. At the higher temperatures, the net energy emitted by the engine liner is not considered to be correctly specified by the surface temperature and the emittance at that temperature. Further, it is noted that the emittance values of the fired engine liners represent only the vicinity of the convergent section of the nozzles. M.W.R.

N68-22439# Atomic Energy Commission Research Establishment, Riso (Denmark).

HEAT TRANSFER BY ORGANIC COOLANTS

N. E. Kaiser Aug. 1967 33 p refs
(RISO-162)

The heat transfer characteristics of organic coolants were investigated in an out-of-pile experiment. A description of the experiment and the measurements carried out is given. The results show that the heat transfer coefficient for a smooth rod in an annulus can be predicted by means of the formula $Nu = 0.0094\ Re^{0.89}\ Pr^{0.4}$ with a standard deviation of about 10% in the forced-circulation region. The above formula is compared with some other similar formulae and shows good agreement in the range of Reynolds numbers investigated. Author (NSA)

N68-22513# Brookhaven National Lab., Upton, N. Y.

HEAT TRANSFER STUDY OF BOILING MERCURY AND MAGNESIUM AMALGAMS UNDER NATURAL CIRCULATION CONDITIONS

M. I. Korneev Jan. 1968 24 p refs Transl. into ENGLISH from Teploenerg. (Moscow), v. 2, no. 7, 1955 p 25–30
(BNL-TR-176) CFSTI: HC$3.00/MF$0.65

Heat transfer from the wall to nonboiling and boiling mercury and mercury amalgams was studied experimentally, and factors influencing the heat transfer at boiling, such as surface purity, pressure, velocity of the liquid and vapor phases (in vertical and horizontal tubes), were examined. Author (NSA)

N68-22514* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

TABLES AND GRAPHS OF FUNCTIONS NECESSARY FOR SOLVING NONLINEAR HEAT TRANSFER CONSTANT AREA FIN PROBLEMS WITH EXAMPLES ON THEIR USE

A. R. Shouman and J. W. Price 23 Feb. 1968 491 p
(NASA-TM-X-53710) CFSTI: $3.00 CSCL 20M

The two functions describing the solution to the nonlinear constant area fin one-dimensional heat transfer problems are evaluated and presented by tables and graphs. The functions allow the solution of the constant area fin problems, assuming constant thermal properties. The case of fins with internal heat generation can be handled using the same functions if the heat generation per unit volume is: a) constant, b) varies linearly with temperature, c) proportional to the fourth power of temperature or d) varies according to a combination of the three cases above. The use of the tables and graphs is demonstrated by considering several sample problems. Author

N68-22542# Columbia Univ., New York. Liquid Metals Research Lab.

HIGH TEMPERATURE THERMAL PROPERTIES OF GASES AND VAPORS Progress Report, Apr. 1967–Mar. 1968

Charles F. Bonilla Dec. 1967 20 p refs
(Contract AT(30-1)-2660)
(CU-2660-39) CFSTI: HC$3.00/MF$0.65

Measurements were made on the viscosity of vapors of Cs, Rb, K, and Na, and the vapor pressure, density-temperature relation, and thermal conductivity of Cs. Velocity fluctuations in the boundary layer of falling liquid films during turbulent fluid flow were also measured. Data are tabulated. NSA

N68-22549# Linde Div., Union Carbide Corp., Indianapolis, Ind.

RESEARCH AND DEVELOPMENT IN A THERMAL INSULATION STUDY Quarterly Progress Report, Sep.–Nov. 1967

W. D. DeWitt and R. L. Reid 22 Jan. 1968 35 p refs
(Contract AT(30-1)-3632)
(ALO-3632-23) CFSTI: HC$3.00/MF$0.65

Thermal conductivity test data were obtained for the following insulations: aluminum foil-aluminum flake opacified glass fiber paper; aluminum flake opacified glass fiber paper; and copper flake opacified Refrasil quartz fiber paper. Long term thermal performance tests were initiated for these insulations to determine thermal stability as a function of time. Air exposure testing of the nickel foil—Refrasil quartz fiber paper combination was initiated. Three air exposure experiments were completed and a fourth is underway. The experimentally determined thermal conductivities were compared with those obtained from an analytical correlation. Mechanical design of the flat plate thermal conductivity test apparatus was completed and fabrication initiated. Two concepts for thermally guarding the insulation sample were analytically evaluated and sample guard specimens are being prepared. The Hastelloy-X vacuum enclosure test specimen has completed approximately 5000 hours of testing without leakage. Author (NSA)

N68-22550# Johns-Manville Research Center, Manville, N. J.

DEVELOPMENT OF 400–800°F FIBROUS-TYPE INSULATION FOR RADIOISOTOPE POWER SYSTEMS: MICROTHERM 20 Cr

J. O. Collins 9 Jun. 1967 15 p
(Contract AT(30-1)-3633)
(ALO-3633-5) CFSTI: HC$3.00/MF$0.65

MICROTHERM 20 Cr was evaluated as a potential thermal insulation for use in radioisotope thermoelectric generators. Due to the similarity between this material and the Johns–Manville family of MIN-K products, Johns–Manville assembled the data on MICROTHERM. The thermal efficiency of MICROTHERM 20 Cr appears to be as good as MIN-K. The other properties are poorer than MIN-K. MICROTHERM will not be considered further for use in radioisotope thermoelectric generators. Author (NSA)

N68-22567 Lockheed Missiles and Space Co., Palo Alto, Calif.

METHODS OF ANALYZING FUNDAMENTAL ELEMENTS OF COOLER-RADIATORS

O. N. Favorskii and Ia. S. Kadaner 1967 14 p Transl. into ENGLISH from the book "Questions of Heat Exchange in Space" Moscow, Vysshaia Shkola, 1967 p 179–196

Design of a rectangular radiating fin is discussed in terms of its use for cooler-radiators in space apparatus, and the necessary equations are presented in detail. The problem of determining the fin profile that has minimum weight for a given quantity of radiated heat is reduced to finding a fin profile that has a minimum cross sectional area. It is shown that a fin with constant temperature gradient corresponds to a fin of most advantageous weight in the case of heat elimination from the fin by convection with a constant heat transfer coefficient. Trapezoidal fins are also considered. M.W.R.

N68-22596# Brookhaven National Lab., Upton, N. Y.
EFFECT OF OXIDES ON HEAT TRANSFER DURING TRANSVERSE FLOW OF SODIUM METAL ACROSS STAGGERED TUBE BANK
V. M. Borishanskii, V. B. Zhinkina, and E. V. Firsova 1967 7 p refs Transl. into ENGLISH from At. Energ. (USSR), v. 22, Apr. 1967 p 317–318
(BNL-TR-184)

Heat transfer was measured on stainless steel tubes having a dia of 28 mm with relative spacings of $s_1/d = 1.25$ and $s_2/d = 1.07$. The range of the basic parameters was as follows: $W = 0.09$ to 1.0 m/sec; $t_{liq} = 300°C$; $Re = 5000$ to 67,000; $Pe = 30$ to 400; oxygen content in the sodium metal = 4×10^{-2}, 2×10^{-2} and 0.4×10^{-2} wt %. The average of the inlet and outlet temperatures was used in determining physical constants such as viscosity, density, etc. The experimental data were fitted in the following form: $Nu = f(Pe)$. The oxygen content in the sodium metal had no effect on the heat transfer. The data could be fitted by one formula with an accuracy of ±30%: $Nu = (Pe)^{0.5}$. NSA

N68-22609# Argonne National Lab., Ill.
MIXED ^{3}He AND ^{4}He CALORIMETER. VERY LOW TEMPERATURE CALORIMETRY
Olivier Testard (Ph.D. Thesis) [1967] 94 p refs Transl. into ENGLISH from the French Rept. CEA-R-3073
(ANL-TRANS-564; CEA-R-3073) CFSTI: HC$3.00/MF$0.65

A general description of the cryostat and its operating principles is given. Discussions are given on the following: liquid nitrogen and helium-4 under atmospheric pressure, vacuum chamber, ^{4}He thermostat, ^{3}He thermostat, experimental chamber, temperature measurement, and other applications. NSA'

N68-22795# Los Alamos Scientific Lab., N. Mex.
EXPERIMENTAL AND THEORETICAL STUDY OF THE GENERATION OF DETONATION BY SHOCK WAVE IN A GRANULAR EXPLOSIVE
H. Bernier, J. M. Lazaud, and Y. Chevalier [1967] 10 p refs Transl. into ENGLISH from Symp. Paper Conf-670914-13 Presented at Intern. Symp. on High Dyn. Pressure, Paris, 11–15 Sep. 1967
(LA-tr-68-2; CONF-670914-13) CFSTI: HC$3.00/MF$0.65

A description is given of experimental results obtained in generating the detonation by shock wave in a hexolite and stress on the testing precautions taken. According to the intensity of the pressure signal, considerable differences are noted when the detonation is produced. A qualitative interpretation of all the results is proposed. They are confirmed for a certain number of points by a mathematical model run through the computer. Author (NSA)

N68-22816# Explosives Research and Development Establishment, Waltham Abbey (England).
AN INTRODUCTION TO HEAT TRANSFER IN HYDROGEN/OXYGEN ROCKET COMBUSTION CHAMBERS
H. Ziebland 29 Apr. 1966 26 p refs
(ERDE-1/S/66) CFSTI: HC$3.00/MF$0.65

A brief introduction to heat transfer processes between the combustion gases and the surrounding cooled walls of a hydrogen/oxygen rocket engine is presented. A fairly comprehensive review is given of known compilations of thermodynamic and transport property data for the hydrogen/oxygen propellant. Effects of undeveloped flow conditions and of physico-chemical phenomena (recombination) on convective heat transfer are discussed, and some recent, yet unpublished results on radiative heat transfer, and on aerodynamic effects on convection in hydrogen/oxygen combustion chambers are presented. In view of these recent experimental observations the importance of extending heat transfer research to the mixing and reaction zone (non-equilibrium areas) of a combustion chamber is pointed out. Author

N68-22966# Brigham Young Univ., Provo, Utah.
THERMODYNAMIC INVESTIGATION OF ALKALI METAL MIXTURES Technical Progress Report, 1 May 1967–1 Feb. 1968
J. Bevan Ott and J. Rex Goates 15 Jan. 1968 6 p refs
(Contract AT(11-1)-1707)
(COO-1707-1) CFSTI: HC$3.00/MF$0.65

The design, construction, and testing of experimental apparatus and the acquisition of commercial equipment and supplies for studies on the thermodynamics of alkali metal mixtures are discussed. Preliminary measurements on the Na–K system are described. NSA

N68-22971# Argonne National Lab., Ill.
A HYBRID-COMPUTER PROGRAM FOR TRANSIENT TEMPERATURE CALCULATIONS ON TREAT FAST REACTOR SAFETY EXPERIMENTS
Lawrence T. Bryant, Lawrence W. Amiot, Charles E. Dickerman, and William P. Stephany Sep. 1967 38 p refs
(Contract W-31-109-ENG-38)
(ANL-7374) CFSTI: HC$3.00/MF$0.65

A detailed description of a hybrid-computer program for temperature calculations in multiregion, axisymmetric, cylindrical reactors. An explanation of the mathematical bases, special features, and input–output format are given; sample problems are included. Temperatures are calculated at node points equally spaced within a region. The hybrid computer consists of a stored-program digital computer with an 8K core memory, linked with an analog computer. The analog computer solves the differential equations resulting from the finite difference approximation to the heat transfer equations; the functions of the digital computer are: parameter input, arithmetic computation of system coefficients, analog potentiometer setting, system check, control and storage and memory. 11 references. NSA

N68-22980# Columbia Univ., New York. Liquid Metals Research Lab.
THERMAL CONDUCTIVITY OF THE ALKALI METAL VAPORS AND ARGON
Chai-sung Lee and Charles F. Bonilla 14 Nov. 1967 17 p refs Presented at the 7th Conf. on Thermal Conductivity, Gaithersburg, Md., 13–16 Nov. 1967
(Contract AT(30-1)-2660)
(CU-2660-37; CONF-671110-3) CFSTI: HC$3.00/MF$0.65

The frequency response to alternating current of a fine wire surrounded by alkali metal vapor was studied theoretically and experimentally for determining the thermal conductivity of the vapor. Data were obtained for cesium and rubidium vapors at 0.0829 to 0.214 atm. A new method was employed of correcting for temperature jump and vapor volumetric heat capacity. In addition, the thermal conductivity of the alkali metal vapors was calculated by gas kinetics theory, including the effects of dimerization and heat of association. Good agreement between experiment and theory was obtained considering the possible errors. The total probable experimental error is estimated at 6.1%, and the uncertainty in the theoretical analysis at about 25%. Reliability of the method is indicated by agreement with literature values for argon up to 1085°C. The standard error of the argon correlation is estimated at 1.6%. Author (NSA)

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N68-21989 Netherlands Research Centre TNO for Shipbuilding and Navigation, Delft.

AMIDSHIPS FORCES AND MOMENTS ON A $C_b = 0.80$ SERIES 60 MODEL IN WAVES FROM VARIOUS DIRECTIONS [KRACHTEN EN MOMENTEN T.P.V. HET GROOTSPANT VAN EEN, SERIES 60—MODEL MET EEN BLOKCOEFFICIENT VAN 0,80 BIJ GOLVEN UIT VERSCHILLENDE RICHTINGEN]

R. Wahab Nov. 1967 22 p refs
(Rept.-100S; TDCK-49790)

The results of experiments on a "Series 60" model with a block coefficient of 0.80, in regular waves acting from 9 different directions, viz. from 10 to 170 degrees are presented. Amidships, at $0.5L_{pp}$ the vertical and horizontal bending moments, the vertical and horizontal shear forces and the torsional moment were measured, together with the ship motions. The tests were carried out at a speed corresponding to Fn = 0.15. The results were used to predict the significant vertical and horizontal midship bending moments in long-crested and short-crested confused seas, for ship lengths between 190 and 400 m. In this case the main direction of advance of the sea was varied from 0 to 180 degrees. Author

N68-22279# Royal Aircraft Establishment, Farnborough (England).

SOLAR-TERRESTRIAL PHYSICS: A GLOSSARY OF TERMS AND ABBREVIATIONS

J. M. Gilliland Jul. 1967 214 p refs
(RAE-TR-67158) CFSTI: HC$3.00/MF$0.65

A glossary of terms, abbreviations, and symbols commonly encountered in solar-terrestrial physics and related fields has been prepared, to serve as a centralized reference and guide for users of the literature. Author (ESRO)

N68-22348*# Scripta Technica, Inc., Washington, D. C.

BASIC PRINCIPLES, METHODS, AND OBJECTIVES OF RELIABILITY OPERATIONS [GRUNDLAGEN, METHODEN UND ZIELE DER ZUVERLAESSIGKEITSARBEIT]

H. Gross Washington NASA Apr. 1968 16 p refs Transl. into ENGLISH from Jahrb. Wiss. Ges. Luft- und Raumfahrt (Cologne), 1966 p 369-377
(Contract NASw-1694)
(NASA-TT-F-11545) CFSTI: HC$3.00/MF$0.65 CSCL 13H

A description is given of a number of theoretical and experimental research methods associated with engineering reliability. A general outline of the basic concepts of reliability operations is presented, followed by a discussion of the various problems that may be successfully attacked by these methods. Author

N68-22558# Israel Program for Scientific Translations, Ltd., Jerusalem.

PRESERVATION OF DOCUMENTS AND PAPERS

D. M. Flyate, ed. 1968 142 p refs Transl. into ENGLISH of the publ. "Problema Dolgovechnosti Dokumentov i Bumagi" Moscow, Izd. Nauka, 1964 Published for Commerce Dept., NSF, and Council on Library Resources, Inc.
(TT-67-51400) CFSTI: HC$3.00/MF$0.65

Aging of paper and the preservation and restoration of books and documents are considered. Compositions of different papers and their biological stability are discussed, along with resistance to attack by mold and an optical investigation of these paper samples. Buffering and ultrasonication of moldy paper are considered preservation methods. The potential use of long-fibered equiresistant paper for book restoration is described, and comparative biological stabilities are presented for these papers when sized with paste and with polyvinyl alcohol. A color process for document photography is described, and a photoelectric image converter is discussed for the preliminary study of documents. Other subjects covered are the protection of paper from the action of light by using filters, the effect of individual stages of sodium chlorite bleaching on the properties of paper, and stain removal from documents. The mathematical treatment of the paper aging process is discussed, and storage conditions in archives are mentioned. M.W.R.

N68-22572# Library of Congress, Washington, D. C. Aerospace Technology Div.

FOREIGN SCIENCE BULLETIN Monthly Review, Vol. 4, No. 4

Apr. 1968 84 p

Presented are the following studies: (1) *Soviet Fast Breeder Technology*—development of competitive fast breeder reactors; (2) *Biological Pest Control*—biological agents to control microorganism, rodents, and insect pests largely immune to chemical insecticides and (3) Surveys—cybernetics, self-adaptive automatic control systems, state of art in bionics, applied mechanics, gas and wave dynamics research at Moscow University. Appendices contain descriptions of an algorithm for recognizing geometrical patterns, a brief review on Soviet rocket engines, and the description of a ground station network for the reception of television programs relayed by satellite. G.G.

[illegible]

EXPERIMENTAL AND THEORETICAL STUDY OF THE GENERATION OF [illegible]

[illegible]

AN INTRODUCTION TO HEAT TRANSFER IN [illegible]

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MOORING FORCES ON A [illegible] MODEL IN WAVES FROM VARIOUS DIRECTIONS [illegible]

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